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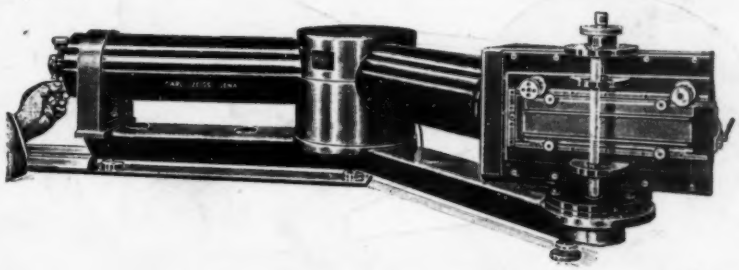

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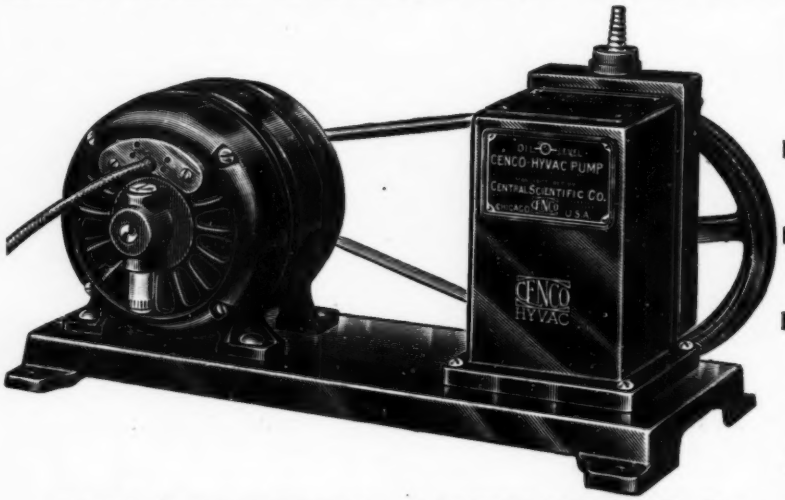

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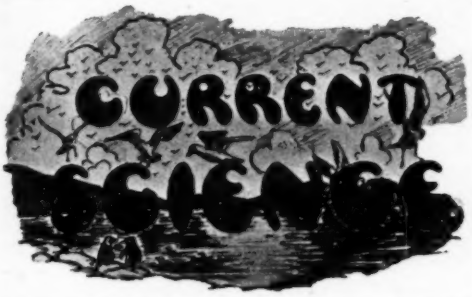

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Planned Economy.*

IN his recent vivacious volume, *Scientific Research and Social Needs*, Prof. Julian Huxley has shown us the close linkage between Science and Industry. The Industrial Revolution of the last century was the result of the application to industry of the scientific discoveries of the time, and since then there has been a continuous application of science to industry, on the mechanical as well as on the chemical side. There has been a remarkable spurt during the post-war period in the application of science to economic life, and we are now living through an Industrial Revolution of far greater magnitude and significance to humanity than the earlier one. It has been suggested that the problem of production has been at last solved, and it is now a question of apportioning work and leisure equitably among the members of a community. The problems of Production which were the main concern of the Industrial West in the 19th century are now replaced by problems of Distribution.

Before the community can attend to these problems, it is necessary to face another, *viz.*, the problem of adjusting the economic framework of society to the altered conditions. Science which has affected the methods of industry and its scale has also indirectly influenced social policy. In the early 19th century, when mankind wanted to reap the fruits of the scientific discoveries, economic progress depended on removing the obsolete and vexatious shackles of Mercantilism and excessive State interference, and therefore Industry only wanted the State to stand out of its sunshine. But side by side with increased production and trade, the evils of unregulated Industrialism were making themselves felt, and interference of the State with Industry to ameliorate the lot of the workers became imperative. For nearly a century State intervention was confined to the field of Distribution, without, however, affecting the structure of industry. The problem of wages and the relief of the unemployed were the chief questions that occupied the attention of economists and statesmen, but it is now realised, as has been pointed out by the Director of the International Labour Office, that "the problem of wages has been

* *Planned Economy for India.* By Sir M. Visvesvaraya, K.C.I.E., LL.D., D.SC., M.I.M.E. Bangalore Press, Bangalore City, Mysore State, British India. Price Rs. 6.

merged in the wider problem of the adaptation of Production to Consumption .... The regulation of labour conditions is no longer so much a matter of protecting the worker against abuse as a part of rational organisation of society." The problem of the hour is to resolve the paradox of Poverty in the midst of Plenty. For, the present economic depression and the widespread unemployment in the World are all due to the fact that we have failed to adopt the organisation of industry to the new phase of mechanical progress which mankind has entered upon without fully realising its social and economic implications. The belief in the powers of self-adjustment of the economic machine has been smothered in the unlifting gloom of the last four years, and there is a growing feeling that the economic life of society must be subjected to conscious collective control. This is the meaning of the demand for Planned Economy.

The question arises whether such conscious collective control should be within the limits set by the present political frontiers, and the State in each country should plan for each as a separate unit, or whether there should not be some approach towards a World Plan. It is a platitude to say that the World has become one, and it has been argued that if the neotechnic economy of the present day is to survive, Industry must be organised on a World scale, and that for two reasons: The first is that the immense advance in the last few years in the means of communication has made physical barriers insignificant and political barriers irrelevant. In the second place, the geographical distribution of the rare earths and metals, which are of supreme significance for the new industrial order, based as it is on Electricity, is such that no country can be independent or self-sufficient. "The basis of the material elements in the new industry is neither national nor continental but planetary, and this is equally true of its technological and scientific heritage."* These facts making for what may be called a long period change happen, however, to be held in check at the present moment by widespread Economic Nationalism with National self-sufficiency for its objective, which is sought to be promoted by hindrances to various kinds of International Trade.

Whether the Economic Organisation of the World is to be unitary, in the sense of a World Plan in which the interests of the parts are rigorously subordinated to those of humanity at large, or a federal one which takes the interests of the parts as the starting point and seeks to reconcile them in a common synthesis, both World Planning and Economic Nationalism have to take account of two tendencies. The first is a continuous reduction of disparities between countries on the economic plane. With the development of automatic and semi-automatic machinery, it is certain that the range of industrial production will rapidly spread even in countries with no previous industrial experience, and it is on this ground that Mr. J. M. Keynes has supported a large measure of National self-sufficiency. Secondly, the basis of modern industry is Power, and the source of power has shifted in the last few years, and it has been argued that "the availability of water-power for producing energy, finally, changes the potential distribution of modern industry throughout the planet, and reduces the peculiar industrial dominance that Europe and the United States held under the coal-and-iron regime. For Asia and South America are almost as well as endowed with water-power—over fifty million horse-power each—as the older industrial regimes, and Africa has three times as much as either Europe or North America. Even within Europe and the United States a shifting of the industrial centre of gravity is taking place: thus the leadership in hydro-electric power development has gone to Italy, France, Norway, Switzerland and Sweden in the order named, and a similar shift is taking place toward the two great social spinal mountain-systems of the United States. The coal measures are no longer the exclusive measures of industrial power."† The combined operation of these two tendencies will bring about a radical change of distribution of the weight of production in the New Order, whether it be cosmopolitan or national in outlook.

World Planning, any more than Economic Nationalism, will not bring peace but a sword, because the advanced countries will be reluctant to surrender their predominance and allow themselves to be converted into 'derelict areas', while the backward countries will be equally determined in their unwillingness to submit

* Mumford, *Technics and Civilisation.*

† Mumford, *op. cit.*

passively to a crystallisation of their present economic status. But the march of events cannot be stayed. "Great economic and social forces flow with ideal sweep over communities only half conscious of that which is befalling them. Wise statesmen are those who foresee what time is thus bringing and try to shape institutions, and to mould men's thought and purpose in accordance with the change that is silently surrounding them" (Morley). India, like other countries, is faced with this problem of reconstruction and adjustment, and it is her good fortune that a statesman of Sir M. Visvesvaraya's authority and learning has given her leaders the fruits of his study, "how best the interests of a backward country like India could be furthered under the complex conditions of present-day civilisation". His work, *Planned Economy for India*, is indeed a tract for the times, but by no means a piece of hurried composition. It represents a slowly-built-up philosophy of life, as well as the results of a life-long study and of strenuous endeavours to enlist the co-operation of his country-men in the task of economic regeneration of their country.

His thesis may be briefly summarised: Economic progress is the pivot round which all other activities revolve, and the spread of the doctrine that poverty is a thing to be tolerated, is a great danger to guard against. At present an overwhelming proportion of the population in India is living below the poverty line. It is necessary that India should be rescued from the double disability from which she is suffering, *viz.*, her chronic economic backwardness, and the acute distress of the present moment as the result of the World Depression. While Indian agriculture should certainly be improved by the adoption of modern methods of scientific agriculture, the centre of gravity of economic reconstruction lies in the sphere of Industrialisation. India needs that a larger proportion of her people should be occupied in industries, and her industrial life should avail itself of mechanisation and mass production methods. These vast changes can only be brought about by the combination of three things: Scientific study of economic conditions with proper organisation of statistics, and an economic survey; creation of institutions, whose purpose will be to study the economic life of the country; and the formulation and operation of a plan of development.

In a Review devoted to the advancement of Science like ours, it is necessary only to touch on what might be called the scientific framework of Sir M. Visvesvaraya's thesis and the manner in which it figures in his important work. There can be no difference with Sir M. Visvesvaraya in his contention that economic activities are the basic condition of higher activities and that poverty is a thing not to be tolerated. There were stages in human history when comfort and leisure were the portion of the few, and hard drudgery the lot of the many. The political centre of gravity has shifted to the masses, who will not tolerate this uneven division of good things in life, while modern science is a powerful ally of Democracy in its demand that poverty shall be abolished for all. If India is to maintain her teeming millions on anything like a decent level of existence, and what is more, if the country is not to become a matter of concern and a menace to the rest of the World, it is necessary that the latest applications of science to agriculture, industry and transport, should be fully utilised so that the volume of production as well as the level of comfort may be raised.

Science is extending its frontiers, and fields of knowledge lying on the margin, or beyond the margin, of scientific study are being brought under cultivation. The life of society itself needs to be brought under the influence of Science, and it is here that the students of Science are under a special obligation to Sir M. Visvesvaraya in his warm belief and vigorous insistence that the facts* and the operations of Indian economic life can and should be subjected to measurement and scientific analysis. Right through his work there is a refreshing appreciation of the value of statistics, and his powerful plea for their proper organisation will surely receive the consideration that is its due. Measurement of social phenomena is yet in its infancy, and in no field of social activities are, perhaps, the need for measurement, and the chances

* Facts are the food of science: if we are going to be scientific about human nature and human society, instead of just trusting to blind social and economic forces (and see what a mess that blind trust has led us into!) let us begin by insisting on a proper supply of facts as grist to the scientific mill.—*Scientific Research and Social Needs*, by Julian Huxley.

of success, greater than in Economics. Economists for a long time were content with qualitative analysis, but in recent years there has been both a recognition of the need for, as well as a growth of, quantitative measurement. Sir M. Visvesvaraya's work is a gratifying indication to the World of Science that we in India are aware of recent developments in this important field of study.

N. S. S. R.

Some Recent Advances in Indian Geology.*

By W. D. West,

Geological Survey of India.

3. The Geology of the Himalaya. †

THE SIMLA-CHAKRATA HILLS.

WE may now consider the second area within the Himalaya which has of late received attention from the Geological Survey of India. In 1925 G. E. Pilgrim and W. D. West began a resurvey of the country between Simla and Chakrata, and were later joined by J. B. Auden. This area had first received attention from H. B. Medlicott so long ago as 1860, and was subsequently the subject of several papers by R. D. Oldham and others. It was Medlicott, however, who laid the foundations of our knowledge of this part of the Himalaya.

A feature of the geology of much of this country, which puzzled Medlicott and subsequent observers, is the occurrence of highly metamorphosed rocks, such as garnetiferous mica-schists and amphibolites, resting on top of practically unaltered rocks, such as the Simla slates. According to Pilgrim and West, these rock groups are not now in their original position relative to one another.[21] Detailed mapping and metamorphic considerations have led them to conclude that the metamorphic rocks, which are really part of the belt of rocks forming the central axis of the Himalaya, have been forced southward for many miles along a nearly horizontal thrust plane, so as to lie now on top of the unaltered rocks. These metamorphic rocks, named the Jutogh series, are seen forming the upper part of the ridge on which Simla is built, the small hill station of Chail, and the greater part of the Chaur mountain south-east of Simla. At the two former localities they occur as true 'klippe', since the effects of denudation have left them as isolated outliers capping the two hills. But the outcrop that forms the greater part of the Chaur mountain continues northwards along a high ridge, and so joins up directly with the main mass of crystalline schists and granites north of the Sutlej river. The Chaur outcrop is thus a direct southward extension of the rocks of the central axis of the Himalaya, and the way in which these metamorphosed rocks extend so far south as a nearly horizontal sheet, overlying the less metamorphosed slate-limestone group of rocks, is one of the most striking features of the geology. In addition to the major thrust plane along which the Jutogh series have travelled, there are other thrust planes in the rocks below, of which the Chail thrust is the most important. The crush phenomena found along the line of this thrust afford evidence of considerable horizontal movement here also. It is possible that the oncoming of the uppermost Jutogh beds like a gigantic wave from the north, induced the formation of the underlying thrusts, the rocks being piled up one on top of the other as a result of great horizontal compression.

Intruded into the Jutogh series there occurs the porphyritic gneissose biotite-granite which forms the upper part of the Chaur peak. This is the same rock as Stoliczka's 'Central Gneiss', and is one of a long series of intrusions stretching from Garhwal to Nanga Parbat. According to Pilgrim and West, the foliation which is found locally in it was developed at the time of its intrusion. Around the granite there is a definite increase in the grade of metamorphism of the Jutogh series, producing very coarse garnet-staurolite-schists, whilst kyanite is sometimes found.

The underlying less metamorphosed rocks comprise a number of series which have been given local names. These include the Chail, Simla, Jaunsar, Krol, Shali, Deoban and Tal series, together with the thin but important Blaini beds, which are now thought to be homotaxial with the Talchir

* Published with the permission of the Director, Geological Survey of India.

† Continued from previous issue, *Curr. Sci.*, 1934, **3**, 231.

[21] *Mem. Geol. Surv. Ind.*, 1928, **53**.

beds of Peninsular India, as first suggested by Oldham. The age of the rest of the rocks is at present quite unknown, though certain deductions may be made. These less metamorphosed rocks have been studied and mapped in detail by Auden along a narrow belt of country lying immediately south-west of the country mapped by Pilgrim and West, extending in an E.-S.-E. direction from Solon on the Kalka-Simla railway to the southern part of the Chakrata district.[22] It seems clear from his work that the rocks of this Krol belt are a thrust mass of Jaunsar-Blaini-Krol-Tal rocks, resting on a floor of Simla slates and Tertiary rocks, from which they are separated by the Krol thrust, which is itself folded. The details of the structures are too complicated to allow of easy summary, but, broadly speaking, there are two thrust-bound synclines overturned towards the south, the northern syncline being brought on by the Giri thrust, and the southern by the Krol thrust. The latter is the more important of the two, separating the Tertiary rocks from the pre-Tertiary. Oldham's 'Main Boundary Fault' comes still further to the south-west. East of Nahan the two latter thrusts meet, the Krol thrust appearing to overlap the other. Towards the south-east end of the belt the northern syncline opens out and includes a mass of Tal rocks, which overlie the Krol rocks unconformably. It will be remembered that comminuted fossils have been found in the Tal rocks of the type locality in Garhwal, but too damaged to be identified. In the southern portion of the Chakrata district, by and east of the Tons river, this belt of rocks is bounded on the north side by another thrust, the Tons thrust. As this thrust dips to the south and south-west, and as the Krol thrust on the south side of the belt dips northwards, it is suggested that the two thrusts are the same and join below, and that the great syncline of Jaunsar rocks, with overlying Krols and Tals, rests as a nappe on a folded thrust plane. The component beds of the two synclines are much folded, but this folding is not regarded by Auden as of structural significance, but as due to the incompetent nature of the beds. The two synclines have behaved as units, which have moved *en bloc*.

A point stressed by Auden is that too much emphasis has in the past been laid on a single 'Main Boundary Fault' as having borne the burden of the advance of the Himalaya, and in particular he rejects Lake's simple explanation of mountain arcs, which has already been referred to. As Middlemiss showed long ago, in addition to Oldham's 'Main Boundary Fault' there are several comparable faults within and bounding the Siwaliks on the one hand, and within and bounding the pre-Tertiary rocks on the other hand. And the more recent work on these latter rocks has only served to extend these observations, and to emphasise the importance of these other thrusts.

As regards the time of intrusion of the gneissose granite which is found in the Jutogh series, and similar granites elsewhere, *e.g.*, Lansdowne, Dudatoli, and the main mass of the Dhaoladhar range to beyond Dalhousie, which seems to be identical with what Stoliczka called the 'Central Gneiss', Pilgrim and West, while refraining from expressing any definite opinion except that it was probably pre-Chail in age and possibly Archæan, rejected McMahon's view that the intrusion took place during the Tertiary at the time of the upheaval of the Himalaya. Auden has now gone further, and has put forward reasons for supposing the intrusion to have taken place towards the end of the Palæozoic, suggesting that it occurred in connection with certain crust movements which he thinks took place in pre-Infra-Krol times, along a line coincident with the line of the old Aravalli mountains if continued north-eastwards from Delhi towards the Himalaya. This recognition of an older structure subordinate to the main Kainozoic structure of the Himalaya in these hills may prove to be important, though it would be surprising not to find evidence of some such break, considering the importance of the break between the Dravidian and the Aryan in so many parts of India. The suggestion that it is an Aravalli structure (based on the direction of minor folds in pre-Infra-Krol rocks, and the direction of orientation of phenocrysts in the Lansdowne granite) must await the results of further observation. Nevertheless it has received considerable support from the gravity investigations of the Survey of India, which suggest that there is an upward buckling of the floor of the Gangetic trough along a line stretching

[22] *Rec. Geol. Surv. Ind.*, 1934, **67**, 357.

from Delhi towards Saharanpur.[23] In an earlier paper Auden discussed the age of certain Himalayan granites, and arrived at tentative conclusions based partly on such tectonic considerations.[24] According to him it seems definite that some of the granites of the Central Himalaya and border ranges closer to the Peninsula were intruded in pre-Triassic times, and belong to pre-Himalayan tectonics, though they are probably of more than one age. Considering very generally this question of the age of Himalayan granites, it appears from recent researches that the youngest type is a tourmaline-granite, the intrusion of which must have taken place in very late Kainozoic times. Another which is common in many parts of the Himalaya is a hornblende-granite with sphene and sometimes epidote. Around Nanga Parbat and in Ladakh it has metamorphosed the Panjal trap, while a similar granite is post-Cretaceous in age in the Everest region.[25] Of probably older age is the porphyritic gneissose biotite-granite, Stoliczka's 'Central Gneiss', so frequently referred to above. It is definitely post-Dogra slate in age, and, according to Wadia, is post-Carboniferous in the Pir Panjal.[26] Finally, pebbles of older granites have been found in the Panjal Agglomerate, in the breccia at the base of Middlemiss's Purple Slate series, and elsewhere. It is thus clear that there are a number of granites in the Himalaya of different ages; but their relative importance, and the part that any of them may have played in the Kainozoic mountain building movements, or in the metamorphism of Palæozoic sediments to crystalline schists, cannot at present be determined with certainty, and will have to await the detailed mapping of one complete section of the Himalaya.

In discussing the metamorphism of the rocks of the Krol belt, which is of a low *epi* type, Auden suggests that the greater metamorphism displayed by the rocks in the Chaur area further north-east is due entirely to the intrusion of the Chaur granite, and rather infers that had there been no granite then the rocks would have displayed no greater metamorphism than the rocks of the Krol belt.[27] His views are based on a general consideration of the metamorphism displayed by the rocks in the Simla area, and in particular on a visit to Lansdowne and an inability while there to find any discordance separating the garnetiferous schists surrounding the Lansdowne granite from the less metamorphosed rocks further away. This is contrary to the opinion expressed by Pilgrim and West, who regarded the Jutogh series as an older set of rocks which everywhere display a *meso*-grade of metamorphism, locally intensified by the Chaur granite. They were impressed with the importance of the Jutogh thrust, which has brought the Jutogh rocks, together with the Chaur granite and its associated igneous rocks, into contact with rocks displaying only an *epi*-grade of metamorphism, or no metamorphism at all. They fully realised, however, the possibility of the Jutogh and Chail series both being older than the metamorphism, which might have metamorphosed them to different grades before the thrusting brought them into juxtaposition. The matter is referred to at some length here because it is a problem of prime importance. Leaving out of consideration the evidence for the Jutogh thrust, it is really a problem of explaining how, on the assumption that there has been no thrusting, the uppermost rocks with a roughly horizontal disposition have come to be intruded with granites, while the underlying rocks have escaped the intrusion. The presence of the Jutogh thrust between the two sets of rocks explains the anomaly, but it is a solution which may have only a local application, and of course throws no light on the relative ages of the rocks. In an unpublished report on traverses in Eastern Nepal, Auden has developed his point of view a step further by definitely suggesting that the Daling series pass up by increasing metamorphism into Darjeeling gneiss, the latter consisting mostly of para-gneiss and schist. Here again the more metamorphosed rocks, with their accompanying ortho-gneiss and granite, overlie the less metamorphosed Dalings. According to Auden the two are the same, the Dalings belonging to the *chlorite* zone of metamorphism and the Darjeeling gneiss to the combined *biotite-garnet* zones. This question of the age or ages of the crystalline schists in the Hima-

[23] *Geodetic Report*, 1933, **8**, 57.

[24] *Rec. Geol. Surv. Ind.*, 1933, **66**, 461.

[25] *Op. cit.*, 1932, **66**, 224; and *Mem. Geol. Surv. Ind.*, 1907, **36**, 183-184.

[26] *Mem. Geol. Surv. Ind.*, 1928, **51**, 223.

[27] *Rec. Geol. Surv. Ind.*, 1934, **67**, 406-419.

laya is full of difficulties and will possibly only be solved in an area where there is no extensive thrusting. The problem is an important one, and with it is bound up the question of the age of some of the granites.

Some 40 miles north-west from Simla, in Mandi State, S. K. Roy has noted folded dolomitic limestones, which he suggests may be Krol in age, resting partly on Kainozoic rocks and partly on slate and volcanic rocks of pre-Kainozoic age.[28] He suggests that these limestones are 'klippe' of older rock resting on younger rocks, their roots being found in Kulu some 16 to 20 miles further east.

As regards the age of the thrusting, Auden has pointed out that the Krol thrust near Kalsi brings the pre-Tertiary rocks to rest upon Nahans. The thrust must therefore be of Upper Miocene or later age. As bearing upon this same question, interesting evidence has very recently been brought forward (but not yet published) by H. M. Lahiri, working between Nalagarh and Anandpur, that is along the edge of the foothills nearly due west of Simla. Over a distance of about one and a half miles Lahiri has found Dagshai beds (Miocene) resting horizontally or with a slight south-westerly dip on the top of boulder conglomerates belonging to the Older Alluvium (Pleistocene). It seems clear that the Dagshai beds must have been thrust over the younger boulder conglomerates, and the thrusting must have taken place in late Pleistocene or very recent times.

One of the most remarkable features about these Simla series—Krol series set of rocks is the complete absence of fossils in them, making it difficult to determine the age of the rocks. The Blaini beds with their supposed glacial boulder bed may reasonably be regarded as homotaxial with the Talchir boulder bed of Peninsular India, and therefore to be of Upper Carboniferous age, though the point is not beyond dispute. But beyond that little can be deduced. It may be asked, how is it that while the thick series of sedimentary rocks on the Tibetan side of the central axis are fossiliferous, and include rocks ranging in age from the Cambrian to the Eocene, the sedimentary rocks on the southern side of the axis are completely unfossiliferous, though they include rocks which must have been formed at the same time. The question is a difficult one to answer. It may be due partly to the fact that many of the limestones of the Simla area are dolomitised, during which process the fossils may have been destroyed. But there are many other rocks such as slates and shales, suitable for the preservation of fossils, which have undergone little or no alteration. Yet so far not even the trace of a fossil has been found in the pre-Tertiary rocks. It is possible that during the long period of time during which deposition was proceeding, the sea over the Simla area was separated from the northern sea or Tethys by high land over what is now the central axis of the Himalaya. And it may be that the physical conditions of this southern sea were unfavourable to the presence of abundant life. That this may have been so is evident from the shallow water nature of many of the rocks, from the evidence which they provide of having been formed under unhealthy conditions, and from the fact that desert conditions may have prevailed over the adjacent land areas, as suggested by Auden.[29] Between the Simla hills and Spiti there occurs the broad belt of the crystalline schists and gneisses forming the central axis of the Himalaya, so that continuous mapping of the limestone-slate series from one area to the other is impossible. Attention, however, may be drawn to the fact that further north-west, to the south-east of Chamba, judging from our scanty knowledge of the geology as represented on the 32 miles to the inch geological map, this dividing belt of crystalline schists is for a short distance very thin. It may be that we have in this locality the opportunity of correlating the unmetamorphosed sedimentary rocks of the two belts. Further north-west, towards Kashmir, there occurs a mingling of these northern and southern seas, and fossils begin to appear. But the exact age of the rocks in the Simla area will not certainly be known until fossils have been found in them, or until continuous mapping has been completed between Simla and Kashmir or between Simla and the Chamba to Spiti section.

Comparison between Simla and Kashmir.

Comparing broadly the structure of this section of the Himalaya with the Kashmir area in the light of recent work, it seems

[28] *Quart. Journ. Geol. Min. Met. Soc. Ind.*, 1933, **5**, 131.

[29] *Rec. Geol. Surv. Ind.*, 1929, **62**, 168.

that the sedimentary rocks of the Krol belt correspond to Wadia's autochthonous zone in Kashmir; while the Jutogh and Chail series and the gneissose-granite correspond to Wadia's nappe zone. Auden's Krol thrust corresponds in position to Wadia's Murree thrust, and Pilgrim and West's Jutogh thrust (or possibly their Chail thrust) to Wadia's Panjal thrust. The chief difference between the two areas is that whereas in Kashmir several basins of fossiliferous sedimentary rocks are found resting in synclines on top of the Kashmir nappe, in the Simla hills–Spiti area nothing similar is seen until one reaches Spiti on the north side of the central axis. It is possible that such rocks once occurred further south than Spiti but have since been denuded away or have been so metamorphosed as to be now unrecognisable.

EASTERN HIMALAYA.

Proceeding further south-east along the range, it has to be regretted that little advance has been made of recent years in our knowledge of the geology of this portion. So long ago as 1875 H. B. Medlicott published a note on the geology of Nepal, which was based on observations made during a journey along the main road to Khatmandu, and from there north-west up to Nayakot.[30] During this journey Medlicott found in a limestone on the crest of the Chandragiri pass 'some small facets of spar having a central puncture, and which I took to be crinoidal; but Dr. Waagen would not say positively that they were so'. Quite recently both Sutton Bowman and Auden have procured better specimens from the same locality, and there is now no doubt about their being fossils. They have been examined by Lahiri, who has identified them as cystids together with the brachiopod orthis. The interest of this discovery will be realised when it is remembered that this is the first discovery of cystids anywhere in the Himalayan area, these fossils having previously been found only in the Burma province. The rocks in which they occur must therefore be of Lower Palæozoic age, though it still remains to correlate them with rocks in adjacent tracts.

As already mentioned, Auden has made traverses recently in Eastern Nepal. As a result of this work he has been able to demonstrate with certainty the continuation westwards from Darjeeling of the Darjeeling gneiss and the Daling series. As noted above, he regards the two as belonging to the same series, but differently affected by metamorphism. Amongst the Tertiary rocks along the southern border of the hills he found Middle and Upper Siwaliks dipping northwards beneath Nahan or Lower Siwalik rocks. There must clearly be a thrust plane separating these two groups, while the Tertiary rocks as a whole are separated from the pre-Tertiary by another thrust, in a manner similar to that found in the Simla-Mussoorie area.

THE MOUNT EVEREST AREA.

In 1921 Dr. A. M. Heron accompanied the Mount Everest Reconnaissance Expedition, and examined an area of over 8,000 square miles around the Arun river and its tributaries, to the north and east of Everest.[31] This is a continuation westwards of the country surveyed by Hayden in 1903-4. The area examined by Heron is divided by him into a northern or Tibetan zone, comprising a thick series of highly folded Jurassic rocks, containing narrow synclines of Cretaceous and Eocene; and a southern or Himalayan zone, in which Everest lies, consisting of foliated biotite-gneisses full of dykes and sills of tourmaline-granite and pegmatite. Between these two zones there lies an intermediate zone of metamorphosed sedimentary rocks, regarded by Heron as metamorphosed rocks of the Tibetan zone. These rocks have a northward dip, so that the gneisses pass upwards into the metamorphic rocks, and the latter upwards into the Jurassic rocks. The metamorphosed sedimentary rocks include crystalline limestones, and actinolite- and epidote-schists. Ascending northwards in the succession the metamorphism decreases, and fossil Spirifer and Productus were found by Heron in the limestone. These rocks in turn pass up into the unmetamorphosed Jurassic rocks. The metamorphic rocks are therefore regarded by Heron as Permian or Triassic in age. According to L. R. Wager, who accompanied the last Mount Everest expedition in 1933, these metamorphic rocks include an upper series of quartzites and shales containing a brachiopod fauna of probable Lower Permian age, underlain by a limestone about 2,000 feet thick, which forms the summit of Mount Everest, and which is probably either Permo-Carboniferous or Carboniferous in age.[32] This in

[30] *Op. cit.*, 1875, **8**, 93.

[31] *Op. cit.*, 1923, **54**, 215.

[32] *Nature*, 1933, **132**, 976.

turn is underlain by a pelitic series much injected by granite. As regards the Darjeeling district, Wager suggests that the Daling series are the equivalent of the Everest pelitic series, while he agrees with the large-scale inversion suggested by Mallet.

Before concluding this section reference must be made to a new edition of Burrard and Hayden's *A Sketch of the Geography and Geology of the Himalaya Mountains and Tibet*, first published in 1908. In the new edition, published this year, the part dealing with the geology has been brought up-to-date by Dr. A. M. Heron, and it should be in the hands of every geologist interested in Indian geology.

Cerebro-Spinal Meningitis.

By Capt. P. Ganguli,

Additional Physician, Medical College, Calcutta.

HISTORY.

IN 1805, an epidemic of cerebro-spinal meningitis occurred in Geneva and Vieusseux was the first man to describe the disease. In 1806 and 1807, the disease was prevalent in the Prussian army. From 1805 to 1830 it occurred in the United States of America and gradually spread from east to west. France was next attacked in 1837 and the disease spent its force in 1874. From 1854 to 1874, the disease occurred both in Europe and in America. From 1875 till now, the disease has spread throughout Europe and America and many places of Asia.

The present Indian epidemic started in the beginning of 1932 in Calcutta, when nearly 40 cases were admitted to the Calcutta Medical College within a month. Subsequently all the cases were admitted to the Campbell Medical School. The disease continued in its sporadic form and has now spread throughout Northern India.

EPIDEMIOLOGY.

Age.—Children are more susceptible to the disease than adults. In the Danzig epidemic, 93 per cent. were under 5 years of age. In Calcutta, however, the disease is particularly prevalent amongst adults. Majority of the cases among children were of chronic character.

Sex.—In Calcutta, more males were attacked than females. As fatigue, chill and overcrowding are predisposing factors, the adults are more liable to infection than others. The purdah system is responsible for keeping the women indoors. The incidence is therefore less among the women. In certain cases, however, where women were exposed to overcrowding, the disease attacked them as well.

Example.—A female came from a moffussil to Calcutta for the anti-rabic treatment of her son. She had to attend the crowded out-door of the Pasteur Institute in the School of Tropical Medicine and Hygiene, and ten days after, she contracted cerebro-spinal meningitis and died within three days of the attack.

The congregation of individuals in meetings, cinema houses, markets, big railway stations, third class compartments, and such like are favourable to the formation of multiple foci and spread of the disease. In well-equipped jails, barracks and schools of Calcutta, however, no cases have been reported. One case was reported from Dumdum jail amongst detenues. According to Major Malaya not a single case has been reported from the Calcutta police lines with a population of six thousand.

The lowered vitality of the population owing to depressed economical condition must be one of the factors. Bad sanitary conditions of the Northern part of Calcutta was responsible for the larger incidence of the disease in that part of the city. The disease is not, however, highly contagious and is not spread by clothing.

Season.—In the case of the European epidemics, the incidence is usually very high in winter whereas in Calcutta, in 1932, the highest incidence was recorded in the months of April and May. 20 per cent. of the cases gave history of exposure to mid-day sun.

Mode of the spread of the disease.—Weigert found presence of purulent rhinitis in many cases of cerebro-spinal meningitis. The meningococci are also found in the nose of many healthy persons, who are the carriers of the disease. The habit of many people to blow out the secretions of their nose indiscriminately in rooms and streets is responsible for the dissemination of

meningococci. During and preceding epidemics, the career rate rises from 2 to 4 per cent. normal to 20 to 30 per cent.

Route of Infection.—The route of infection is through the nasopharynx. The organism sets up rhinopharyngitis, then the meningococci infect the meninges directly from the nose. This is the view held by Nelter and Detere (1911). The other view is that it is a hæmatogenic infection. The meningococci pass into the blood stream and are thereby carried to the meninges. This view is supported by the fact that in 25 per cent. of the cases, blood culture is positive. Esler, for example, reported that he recovered meningococci from the blood of 10 cases out of 41. Moreover, the organisms can be cultured from petechial spots just as *B. typhosus* can be recovered from roseolar rashes of the enteric fever.

BACTERIOLOGY.

It was in the year of 1887 that Weichselbaum of Vienna first discovered the organism which on account of its intracellular character was named *diplococci intracellularis meningitidis*. That the organism was the cause of the disease was proved by the fact that Weichselbaum was able to cause the death of rabbits by subdural injection of the organisms into the skull and he recovered the cocci from culture of cerebro-spinal fluid of experimentally infected rabbits. Intra-pleural and intrathecal injections of the organisms caused death of guinea-pigs in 1 to 3 days. In dogs, subdural injections caused leptomeningitis with acute encephalitis and death occurred within 12 days.

In 1905, Von Lingelsham produced the disease in monkeys. In 1907, Flexner made experiments with *Macacus rhesus* which died within 18 hours to 4 days preceded by general convulsions. In post-mortem examinations, leptomeningitis, encephalitis, abscesses, hæmorrhages into pia-mater were found.

Serological Classification.—The English workers recognise four types (I, II, III, IV) as serologically determined by Gordon. The Rockefeller Institute recognises two types as determined by Dopter, *viz.*, meningococci and parameningococci. Dopter further subdivided parameningococci in α, β and γ varieties respectively. Nicolle, Debains and Jonan divided meningococci into types A, B, C and D. These types were differentiated according to the predominance of different antigenic contents, *viz.*, A, B, C and D. In type I, A predominates. Similarly, in types II, III and IV, B, C and D predominate. These antigenic contents are not equally balanced. This can be illustrated by the following scheme :—

Gordon's I and III strains correspond to Nicolle, Debain and Jonan's type A.

Gordon's II and IV strains correspond to Nicolle, Debain and Jonan's type B.

Dopter's meningococcus corresponds to Nicolle, Debain and Jonan's type A.

Dopter's parameningococcus α corresponds to Nicolle, Debain and Jonan's type B.

Dopter's parameningococcus β corresponds to Nicolle, Debain and Jonan's type B or C.

Dopter's parameningococcus γ corresponds to Nicolle, Debain and Jonan's type D.

Causes of Sporadic Occurrences.—Meningococci carriers are not uncommon. The germs inhabit the nasopharynx. They are usually non-virulent in non-epidemic times but certain strains of the cocci are sufficiently virulent to attack very young children who lack defensive forces and are susceptible. Hence we have cerebro-spinal fever occurring sporadically amongst us.

Morbid Anatomy.—The meninges are actually congested and fibro-purulent exudation collect between dura and pia mater. In acute cases, the whole cortex is covered with thick pus. The cord is also involved and covered with purulent exudate, which is distributed more in the dorsal and lumbar regions than the cervical regions.

Microscopically, the exudate is full of polymorphonuclear cells, containing meningococci. These leucocytes are closely packed in fibrinous material.

DIAGNOSIS.

Clinical Diagnosis.—Besides Kernig's and Brudzinisky's signs, the disease can be clinically diagnosed mainly by the sudden onset of fever, pain, stiffness, rigidity and retraction of the muscles of the neck, pains in the back, orthotonus, tremor and headache. In severe cases, the patient becomes delirious and unconscious. In children, clonic spasms are frequent, and in a few adults, both clonic and tonic spasms are sometimes manifested. Herpes is common due to affection of the posterior ganglion. The pupils are usually contracted and sometimes unequal. Strabismus is not uncommon.

Classification of the Disease.—(1) In the beginning of the epidemic, *foudryant* or malignant forms are common. There is sudden rise of temperature which, however,

is not very high, but malaise, lassitude, stupor, low condition, feeble pulse and such other symptoms all indicate the seriousness of the disease. There is usually the appearance of rash, petechial, purpuric and sometimes this resembles the Malaccan smallpox. The patient quickly becomes unconscious and death occurs in 5 to 24 hours.

(2) The ordinary form has already been described.

(3) In the chronic form, the fever is persistent for two to six months and is characterised by a series of ups and downs. In favourable cases the temperature gradually comes down, spasms become less and less manifest and consciousness returns. Various complications may, however, arise in this condition. They are hydrocephalus, abcess of the brain, pneumonia, pleurisy, pericarditis, parotitis, polyarthritis, persistent headache and such like.

(4) Some cases occur as abortive forms, in which the onset is like that of acute cerebro-spinal fever, but the symptoms suddenly subside and the patient recovers quickly.

Other Varieties of Cerebro-Spinal Meningitis.—Besides meningococci which invade meninges in sporadic and epidemic forms, there are other organisms which may cause cerebro-spinal meningitis. They are pneumococci, streptococci, tubercle bacilli, influenza bacilli, bacilli typhosus including (para A and B), plague bacilli, virus of mumps and such others.

The *pneumococcal meningitis* is invariably fatal. A few cases have recently been reported to have recovered after exhibition of Felton's serum. It occurs more commonly in children than in adults.

The *streptococcal meningitis* is usually an extension of septic infection from middle ear disease and perforated wounds of the skull. The streptococci are usually of hæmolytic type. The disease is usually fatal.

The *tubercular form* is usually common in children and is practically always fatal.

The *influenza bacilli* can cause meningitis. The bacilli are found in long thread-like forms in cerebro-spinal fluid. They resemble Pfeiffer's bacilli but differ in exhibiting a high pathogenicity. Intra-peritonial injection of these bacilli into guinea-pigs and rabbits is followed by purulent effusion into serous cavities. According to Bender, influenzal meningitis is fatal in 91 per cent. in children and 44 per cent. in adults.

The meningitis which occur as complication of typhoid or paratyphoid fevers is fatal in 50 per cent. of the cases. The cerebro-spinal fluid is clear or turbid but seldom purulent like that of meningococcal meningitis.

Laboratory Diagnosis.—The blood examination shows polymorphonuclear leucocytosis with increased stabkernige and younger forms. Traces of albumin are present in the urine. The most important method of laboratory diagnosis is the examination of cerebro-spinal fluid got from lumbar or cisternal puncture. The fluid is centrifuged and the sediment is spread over a slide, stained by Gram's iodine and counterstained by carbolfuchsin. The meningococci are gram-negative diplococci usually found within the polymorphonuclear cells which are abundantly increased. In cerebro-spinal meningitis, the polynuclears predominate, in tubercular meningitis the lymphocytes are most abundant. The coccal organisms are gram-positive in streptococcal and pneumococcal meningitis. These gram-positive organisms can be easily differentiated by morphological appearances and their disposition. The cerebrospinal fluid of tubercular meningitis shows reduction of both sugar and chlorides. The normal amount of sugar in cerebro-spinal fluid is 45 to 95 mg. and of chlorides is 720 to 750 mg. per 100 c.c. In tubercular meningitis, the estimation of chlorides is very important for prognostic purposes, especially in children. Ordinarily the amount of chlorides is reduced to 650 or 680 mg. but in children 580 to 500 mg. may be reached. The globulin is increased even in early stages.

For determining whether globulin is increased or not, either Ross Jone's test or Pandy's test may be done. In Ross Jone's test a distinct white ring of globulin is formed at the junction of saturated solution of ammonium sulphate and cerebro-spinal fluid in a test tube. In Pandy's test, if a drop of cerebro-spinal fluid is put in a saturated solution of carbolic acid, a smoke-like white cloud is formed instead of faint opalescence as with normal cerebro-spinal fluid.

For final diagnosis of tubercular meningitis inoculation of guinea-pigs is confirmative.

Vincent and Bellot's Precipitin Test.—Half a c.c. of antimeningococcal serum is added to 5—10 c.c. of cerebro-spinal fluid and kept in an incubator at 37°F. for 12 hours. A turbidity is developed if the patient is suffering from cerebro-spinal meningitis.

Culture.—This is the surest way of diagnosis. One c.c. of cerebro-spinal fluid is spread over two or three plates of ascitic agar or Gordon's trypagar. Colonies are formed within two days. The cocci are suspended in normal saline. A small quantity of this emulsion suspension is treated with each type serum in water bath for 4 hours at 55°C. If agglutination occurs against a particular type serum, the meningococci belongs to that group.

Agglutination Test of Blood Serum.—The test is positive only in 50 per cent. of cases. The agglutinins are not formed in markedly toxæmic cases. According to Symmeris and Wilson, the serum of cerebro-spinal meningitis occasionally agglutinated *B. typhosus* and *B. coli* even in high dilutions.

Naso-pharyngeal Culture.—The organisms live in the posterior nasopharynx. The smear should be collected with West's swab, which is a bent wire applicator with a sterile cotton tip put within a bent glass tube, so that the cotton tip can be protruded or retracted at will. This tube is introduced into the nose and when it has passed the soft palate, the cotton swab is pushed out so as to get the material from the nasopharynx and is at once smeared on ascitic or serum agar. The smear from the nasopharyngeal region can also be examined on a glass slide but it has to be differentiated from micrococcus catarrhalis. The meningococci are usually found within the polymorphonuclear cells but they may be extracellular. They may be easily differentiated after culture.

Autolysis.—Occasionally, the cerebro-spinal fluid is full of pus cells but no meningococci can be detected in them nor is the culture positive. In these cases, the meningococci have undergone autolysis. The streptococci and pneumococci do not undergo any such autolysis. Hence if the cerebro-spinal fluid contains abundance of pus cells, yet no meningococci, the case is almost surely meningococcic meningitis.

Prognosis and End Results.—During irritative stages, the pupil remains contracted and deep jerks become exaggerated. The dilatation of the pupils and disappearance of the jerks indicate impending death. Oedema of the lungs is always of bad prognosis.

Prophylaxis.—The disease is notifiable. Cases should be isolated at once. The contacts should have gargles of thymol solution or salt solution. The nasopharynx can be reached by means of intranasal sprays of chloretone inhalent, mistol, hexyl resorcinol, or they can be applied by bent camel hair brush through the opening of the mouth. It has been found, however, that all these methods of local disinfection are valueless. Even prophylactic treatment with immune serum has not got any definite value.

During an epidemic, 20 to 30 per cent. of healthy persons carry meningococci in their nasopharynx. In congregation and overcrowding, the infection may spread from carriers to healthy people. It is necessary to stop meetings, cinema and theatrical shows unless the houses are air-conditioned and adequately ventilated. In barracks and jails, systematic examination of nasopharynx should be done and carriers isolated in a separate block. The spacings between cots should be increased and strict supervision of sanitary measures should be undertaken.

Vaccination.—Vaccination is quickly followed by production of antibodies in the system and is certainly effective so far as prophylaxis is concerned. The carriers do not usually get the disease. The medical practitioners, nurses and hospital attendants seldom get the disease. The English naval statistics indicate that the disease almost always develops in those who have previously shown negative cultures from nasopharyngeal smears. This is an additional factor to support that carriers develop antibodies in their system to some extent, but they may get the disease if they are exposed to resistance reducing factors, like exposure to chill, cold, excessive fatigue and such like. These carriers are vastly more common in winter than in summer.

TREATMENT.

The patient should be kept quiet; all causes of irritation should be removed. Special attention is to be directed against bed sores. The hair should be clipped or shaved; icebag should be applied to the head. Water should be given freely.

As the patient usually suffers from constipation, 5 grains of calomel should be given in the evening followed by saline purge next morning. Later, daily enema of soap and water in which two tea spoonfuls of castor oil or an ounce of olive oil is mixed, should be given.

For severe headache, general pains and vomiting, morphia has been frequently used. It quietens the restlessness and irritability, relieves pain and vomiting and procures sleep. Dr. Koplik is, however, of

opinion that morphia is harmful. Every one is, however, agreed about the efficacy of lumbar puncture, which relieves headache by reducing the pressure on duramater. The elimination of toxins with cerebro-spinal fluid will cause subsidence of irritation of vomiting centre. If these symptoms are not relieved by lumbar puncture, chloral hydrate and bromide, ten grains each, should be tried before giving morphia.

Hydropathy.—Hot baths are very soothing, and, if possible, should be given every 3 hours. It will reduce the temperature and sometimes induces sleep.

Serum Therapy.—Jochmann first introduced this treatment. In 1907 and 1908, Flexner and Jobling prepared sera from goat, horse, rabbit and guinea-pig. Out of 1,294 patients treated with serum, 894 recovered and 400 died. The mortality was thus reduced from 74 to 30 per cent. The earlier the serum was given, the better was the result. The leucocytes which increased to about forty thousand, fell to normal within a week after serum treatment. Pus cells became fewer and the cerebro-spinal fluid became less turbid. Another striking feature was that the complications were lessened by serum therapy. The usual complications in those epidemics were iridocyclitis, panophthalmitis, deafness due to internal ear disease, pleurisy, pericarditis, endocarditis, arthropathies, insanity and others.

The mode of preparation of serum varied in different countries. There is no laboratory method by which therapeutic power may be correctly determined. Some rely on *compliment fixation* test, some on *opsonin* content, some on *protective* power. Gordon relies on *anti-endotoxic* power. Riviere and Roux proposed a *precipitin* test.

The failure of serum in many hands is due to preparation from different strains. In the year 1932, out of 43 patients admitted into the Medical College Hospitals, Calcutta, only three survived although everyone was treated with foreign brand serum. A great majority of these cases were foudryant or malignant forms; no impression was manifested by exhibition of those sera. It was understood that the failure was due to sera obtained from different strains of American and European meningococci. Failing to get any good result from foreign brand sera I sent some cultures and cerebro-spinal fluids of my patients to Dr. B. B. Sen of Bengal Immunity Co., requesting him to find out the type of meningococci and also to prepare the serum from the local strains isolated from my patients. He brought materials not only from me but also from the Campbell Hospital, Calcutta, where special accommodation for treating meningitis cases was subsequently created. Out of 25 samples collected by him, one contained streptococci and another pneumococci; from the rest eleven strains of meningococci were isolated. Nine were found to correspond to Gordon's type IV and two to type II. That is to say, at the beginning of the year 1932, the prevailing organism of the epidemic were of Gordon's II and IV types, which were the same as Nicol, Debaun and Jonan's β-type or Dopter's parameningococcus α-type. Next year, research workers of the Bengal Chemical Works took up the investigation. Out of 150 samples of cerebro-spinal fluid, 120 showed meningococci. It was found that in none of the samples type II or IV were detected. All of them showed either Gordon's type I or type III which were the same as Dopter's typical meningococci and Nicol's, Debaun's and Jonan's type A. It is, therefore, evident that the types may vary in different epidemics in the same place in different years.

In the latter part of the year 1932, several more cases were treated by me. In all of them locally manufactured sera were used. The result was very satisfactory, as 5 of them recovered, and 2 died, giving a mortality of 39 per cent. In the year 1933, the results were still more satisfactory. 15 cases were treated with sera manufactured in Calcutta, both intrathecally and intravenously and no less than 13 survived and the mortality was 14·3 per cent. All these patients also received Schering's urotropin, intravenously every day as a routine measure.

Dose of Serum.—The quantity of serum to be given intrathecally varies in different individuals and depends on how much cerebro-spinal fluid is withdrawn. On no account serum should be introduced in quantity larger than the amount taken up. Sometimes, the cerebro-spinal fluid comes out under great pressure and even after 100 c.c. have passed out, the rate of flow still remains over 60 drops per minute. In these cases it has been advised to draw out fluid in two or three instalments of 60 c.c. each, and give intrathecally 20 c.c. of the serum. On the other hand, Stitt recommends that the cerebro-spinal fluid should be drained out

till 4 or 5 drops come out in a minute. Personally I have not seen any untoward result by draining up large quantities of cerebro-spinal fluid. In my cases when the rate of flow becomes less than 30 per minute, I raise the head and the shoulders a little, with the result that it flows out more quickly and then once the rate flow goes down below 30, it quickly comes down to 9 or 10 per minute, when no more fluid is allowed to come out. 20 to 30 c.c. of serum is then introduced slowly with the head brought down to level position. After this, the head and the shoulders are kept low, and the pelves raised. At the same time 60 to 80 c.c. of serum is given intravenously. The intravenous medication is more urgently indicated if meningococci are found in blood culture. In 1918 Herrie recommended this combined method of medication. The total amount of serum for every individual was an average 100 c.c. intrathecally and 400–500 c.c. intravenously In Herrie's experience the mortality where serum was given intrathecally was 34 per cent. but by combined intravenous and intrathecal methods the mortality was 14·8 only. My own experience was entirely corroborative of Herrie's

Cisternal Route.—In some cases, where there was arrest of clinical improvement due to the impairment of communication between ventricular and spinal fluids, cisternal puncture was done and serum introduced by this route. Lenkowicz found that the spinal fluid became thick owing to the increase of protein contents. He found that communication of ventricular and spinal fluid was arrested when the protein contents of spinal fluid becomes more than 5 times that of ventricular fluid. In such cases, where lumber route gives a dry puncture, cisternal puncture should be done. Vast numbers of cases were treated by this route in the Campbell Medical School of Calcutta with success.

Serum Meningitis.—In two cases, patients were seen to relapse after 10 or 12 days of apparent improvement and became delirious comatose again. The temperatures, which were normal, shot up again to 101° or 102°. Both these cases complained of joint pains and itching sensations all over their bodies. This led me to suspect serum meningitis in which urticaria is generally present. But the dark complexion of these patients perhaps masked these appearances in their skin. Injection of adrenalin and calcium gluconate quickly restored the temperature to normal and the patients gradually recovered.

In cases of doubt, lumber puncture should be done. In serum meningitis, the fluid is usually clear and the poly-morphous cells do not show meningococci. There is increased albumen but glucose is not diminished as in tubercular meningitis which shows a relapse of these bad signs after apparent improvement.

Value of Vaccines.—There is no doubt that those cases which show tendency to become chronic are quickly benefited by exhibition of vaccine. The antibodies are rapidly developed. Taylor is of opinion, however, that the antibodies do not pass into the cerebro-spinal fluid.

Value of Hexamin.—Osler recommends 30 to 50 grains of hexamin daily as prophylactic measure. In all my cases, urotropine was given as a routine measure, both *per os* and intravenously. Dr. P. Banerjee of Howrah got excellent results with cylotropine in five cases.

Value of Mercurochrome.—0·1 per cent. solution of mercurochrome was tried intrathecally with doubtful results.

Complications.—Respiratory disturbances may appear in some cases, which are best treated with Tr. Ephedra or adrenalin. In a few cases arthropathies develop for which serum may be injected into the joints. I would strongly recommend vaccine in these cases.

Conclusions.—(1) Besides general hygienic measures, prophylaxis by means of vaccine may be attempted.

(2) Serum should be given both intrathecally and intravenously.

(3) Local brands of serum are strongly recommended.

Obituary.

Prof. Willem de Sitter (1872-1934).

WE regret to record the death of Prof. Willem de Sitter, one of the leading astronomers of the present time. He was born on the 6th May 1872, prosecuted his University studies at Groningen and worked in the astronomical laboratory there till 1896. Later he was appointed Professor of Astronomy at Leyden, a famous place for its old astronomical laboratory and then became the director of the laboratory in the year 1918. In the years 1917–1918 he contributed three papers to the *Monthly Notices of the Royal Astronomical Society* expounding the then new theory of gravitation and introducing his conception of the Universe, the "de Sitter Universe". His researches were the nuclei of further work in cosmology but "he was the man who discovered a universe and forgot about it". For about ten years after, he devoted himself to the reorganisation of the laboratory at Leyden. In 1931, he was invited to deliver the Lowell lectures on "Cosmology" at Boston.

His last paper was "On the foundations of the theory of relativity, with special reference to the expanding universe" published in the last November issue of *Proc. Kon. Akad. Wet.* He died on November 19 and in him the astronomical world has lost an eminent scientist.

Science and Crime.

THE prospect of a reorganisation of the police force lends point to the necessity, emphasised by Mr. H. T. F. Rhodes in a recent paper before the International Faculty of Sciences, for a strengthening of the scientific branch of the criminal investigation department. Criminals are becoming more and more trained scientists, with a knowledge of many of the things that can be or have been discovered by research, and crime detection therefore tends to become increasingly a matter of chemical and physical analysis. There is no reason why a body of chemists and physicists attached to the police and permanently engaged in police work should not become so expert as to rival the legendary Sherlock Holmes in the ingenuity of their methods. In the provinces as well as the Metropolis there is an increasing recognition of the need for scientific methods; for example, since Mr. Rhodes read his paper, we notice that the latest scientific appliances for the prevention and detection of crime have been included in the equipment of the new police headquarters at Newcastle-on-Tyne.

The chemist is a professional detective in his daily work, and in the realm of crime detection he may be relied upon to apply himself to his investigations with the same impartiality as he displays in his own laboratory. There is no need to divide the "technical police" into two departments, one for the prosecution and one for the defence, as has been suggested in some quarters, for the whole department, like the police force itself, should be quite capable of sifting the evidence without fear or favour and submitting it to the tribunal which has to decide the issue. All that is necessary is to ensure that the scientific police are recruited with the utmost care. The personnel must not be chosen from the young and inexperienced but from those who have achieved some eminence in scientific investigation. We commend this aspect of the matter to the attention of the official bodies, the Institute of Chemistry, the Institute of Physics and the British Association of Chemists.

Letters to the Editor.

Seismometric Study of the North Bihar Earthquake of January 15, 1934 and its Aftershocks.

IN a note on "The Focal Region of the North Bihar Earthquake of January 15, 1934", published in the last May issue of *Current Science*,[1] it was pointed out that the phases P, $\overset{*}{P}$, $\overline{P}$ and S, $\overset{*}{S}$, $\overline{S}$ were identifiable on the records of the Indian seismic stations lying within an epicentral distance of about 1000 kms. Since then it has been possible to obtain and study the original seismograms of some Indian stations and also photostat copies of records from the neighbouring extra-Indian stations within a distance of 6000 kms. It may be of interest to note that the phase $\overline{P}$ appears to be identifiable on the seismograms of such distant stations as Bombay ($\Delta = 1610$ kms.), Medan ($\Delta = 2877$ kms.), Batavia ($\Delta = 4255$ kms.) and Amboina ($\Delta = 5617$ kms.). As far as the present writer is aware the phase $\overline{P}$ has not been detected on the seismograms of any previous earthquake shocks at epicentral distances greater than 1000 kms. If the author's reading of the seismograms of the great North Bihar Earthquake is correct, the observation of $\overline{P}$ to a distance of at least about 6000 kms. would be an useful addition to the existing knowledge of the time-distance curve of this seismic phase. Another interesting feature of the seismograms of the great shock is that the incidence of the primary wave with definite big impetus (iP) was preceded by emergent small tremors (eP) of a few seconds' duration. The phases eP and iP are seen clearly on all the available records. This character of the P-incidence has also been

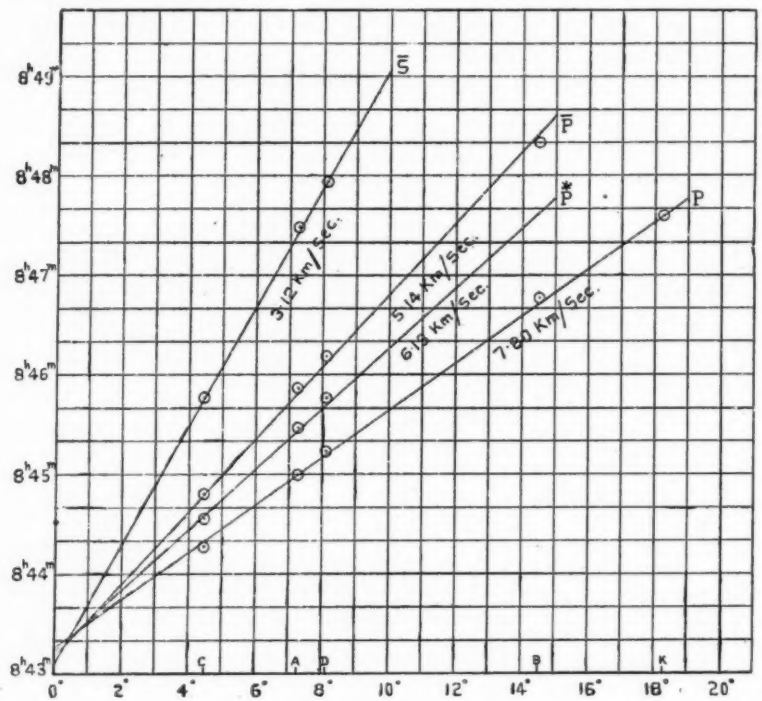

Fig. 1. Jan. 15, 1934.
Epicentre: Lat. 26° 36′N., Long. 86° 12′E.
Origin Time: 8h 43m 16s (G.M.T.) (eP).

[1] *Curr. Sci.*, 1934, **2**, 419.

noted independently in the tabulations of the shock by such distant stations as Hongkong, Nanking and Kew. The duration of the fore-running tremors (eP) is within 6 to 8 seconds at different stations, and may be regarded as constant at all distances. This seismographic observation may be explained by supposing that the major failure which led to the great shock was preceded by a minor failure by about 6 to 8 seconds. The epicentral region of the great shock of January 15 is located near Lat. 26·6° N. and Long. 86·2° E. with origin time of eP as 8 h. 43 m. 16 s. G.M.T. The time-distance curves of the phases P, $\overset{*}{P}$, $\overline{P}$, S, $\overset{*}{S}$, $\overline{S}$ of the great shock of January 15 are given in Fig. 1. Similar curves have also been obtained for the aftershocks of January 16 and 19 (Figs. 2 and 3). The average velocities (α) of the

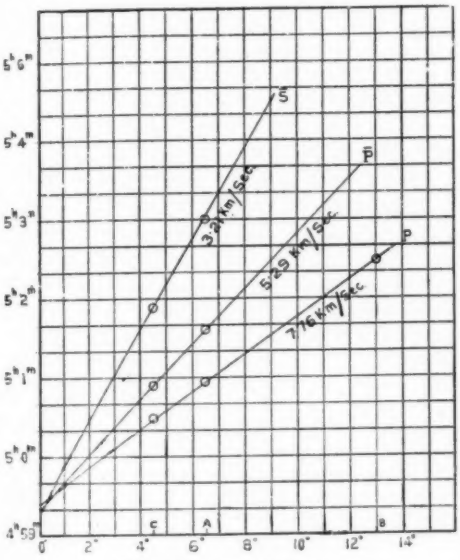

Fig. 2. Jan. 16, 1934.

Epicentre: 26° 12′N., 85° 18′E.

Origin Time: 4h 59m 23s. (P).

three longitudinal waves and those (β) of the three distortional waves calculated from the seismic data of the North Bihar shocks are:

	$\alpha\times10^{-5}$ (C.G.S.)	$\beta\times10^{-5}$ (C.G.S.)
Upper layer (Granitic)	5·23 ($\overline{P}$)	3·17 ($\overline{S}$)
Intermediate layer (Basaltic)	6·24 ($\overset{*}{P}$)	3·72 ($\overset{*}{S}$)
Lower layer (Ultra-basic)	7·78 (P)	4·26 (S)

The bulk-modulus K corresponding to the above velocities are:

	$K/P=(\alpha^2-\frac{4}{3}\beta^2)\times10^{-10}$ C.G.S.
Upper layer	14·0
Intermediate layer	20·5
Lower layer	36·3

These values of bulk-modulus when compared with the laboratory determinations of

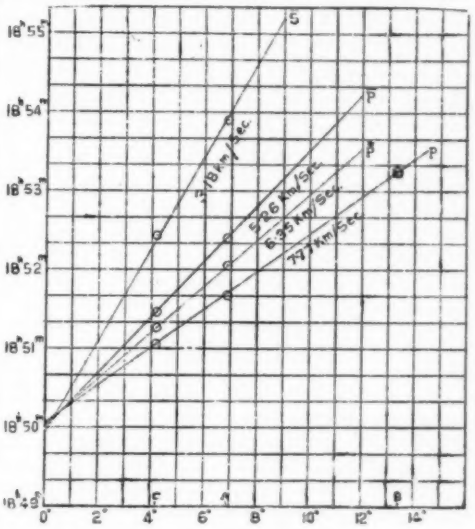

Fig. 3. Jan. 19, 1934.

Epicentre: 26° 12′N., 85° 36′E.

Origin Time: 18h 50m 2s. (P).

elastic constants of Obsidian, Granite, Diorite, Basalts, Dunite, etc., at probable temperatures and pressures at the different layers may throw some light on the constitution[2] of the outer crust of the earth in Bihar. An extrapolation of the time-distance curves of P, $\overset{*}{P}$, $\overline{P}$, S, $\overset{*}{S}$, $\overline{S}$ to the origin show that the apparent delay in start of $\overline{P}$ with respect to $\overline{S}$ is 3·3 secs., that of $\overset{*}{P}$ with respect to $\overline{P}$ is 1·5 secs., and that of P with respect to $\overset{*}{P}$ is 3 secs. From the foregoing data the focal depth of the North Bihar shocks is calculated[3] to be about 13 kms. The thickness of the upper layer is estimated to be 13·7 kms., and that of the intermediate layer as 22·2 kms. The focal depth and the thickness of the upper layer suggest that the major failure leading to the

[2] *The Earth*, by Jeffreys, pp. 101-102.

[3] *Loc. cit.*, pp. 97-98.

disastrous earthquake of January 15 occurred near the boundary of the upper and intermediate layer of the earth's crust. A detailed seismometric study of the North Bihar shocks will be published elsewhere.

S. C. ROY.

Colaba Observatory,
Bombay,
December 28, 1934.

Renoflavin and Vitamin B_2.

SINCE we obtained renoflavin from ox-kidney extracts,[1] we have been examining its vitamin B_2-potency by observing its growth-promoting effect, at different stages of purification of the flavin, on rats maintained on a "Vitamin B"-deficient diet, supplemented by a preparation of vitamins B_1 and B_4, obtained from yeast according to Peters' method. It has been found that fairly concentrated fractions of the pigment are unable to promote good growth even in doses considerably larger than the effective dose, reported by Kuhn. In the quest of a possible missing factor we have found that the rate of growth could be very appreciably enhanced by supplementing relatively small doses of the flavin concentrates with the filtrate, left after adsorption of the ox-kidney extract with Fuller's earth, which we had previously heated at pH 9·0 for half an hour in an autoclave at one atmosphere pressure in order to destroy traces of vitamins B_1, B_4 and the flavin. This would indicate an apparent complexity of what is regarded as vitamin B_2 and would show that one of the factors involved, other than the flavin, is a relatively heat- and alkali-stable substance.

B. C. GUHA.
H. G. BISWAS.

Biochemical Laboratory,
Bengal Chemical & Pharmaceutical Works, Ltd., Calcutta,
November 28, 1934.

The Occurrence of *Isœtes* in India.

So far only one species of *Isœtes* (*I. coromandelina* L.) has been reported to be found in India. It grows very commonly on the Coromandel Coast; Fyson collected it from Madras and Kashyap from near Seven Pagodas (Madras), as has been recorded by Pfeiffer.[2] Another place from where it has been collected is Serampore in Bengal and that was by Griffith, as stated by Prain.[3] Ekambaram and Venkatanathan[4] have also referred to only these two places. It would, therefore, be of some interest to record that the writer collected a species of the plant on the 14th October, 1930, from a shallow pond about a mile or so away from the Benares Hindu University grounds. Subsequently more places were found where it grew. Collections have been made from time to time from various localities, and it has been ascertained that this plant grows very abundantly within a radius of ten miles or so from this University.

The Benares species resembles *I. coromandelina* in practically all respects except that the former has got the preponderance of four-lobed stocks which character has been described by Pfeiffer to be a rarity.

Y. BHARADWAJA.

Department of Botany,
Benares Hindu University,
December 1, 1934.

A Preliminary Note on the Occurrence of Liane Type of Structure in the Stem and Root of *Thylacospermum rupifragrum*, Schrenk.

Thylacospermum rupifragrum, Schrenk. is a plant of the elevated and arid regions of Western Tibet and is characterised by an extremely compact cushion habit. Its young stems and roots possess the usual structure characteristic of dicotyledons; the primary organisation and early secondary growth are of the normal type—the normal or primary cambium developing bast on its outside and wood on its inside in a uniform manner. During later stages of development of both the stem and root some cells of wood parenchyma assume meristematic activity and so constitute strips of secondary cambium on the inside of the normal vascular cylinder. The secondary cambial strips develop xylem on the side facing the xylem formed from the primary cambium and phloem on the side removed from it. Sooner or later vascular tissue resulting from the activity of the different strips becomes distinct from the original vascular tissue by crushing the

[1] Guha and Biswas, *Curr. Sci.*, 1934. **2**, 474.
[2] Pfeiffer, N. E., "Monograph of the *Isoëtaceæ*," *Ann. Miss. Bot. Gard.*, 1922, **9**.
[3] Prain, D., "The Vegetation of the Districts of Hughly—Howrah and the 24-Pergunnahs," *Rec. Bot. Surv. Ind.*, 1908, **3**.
[4] Ekambaram, T., and Venkatanathan, T. N., "Studies on *Isœtes coromandelina* L.," *Journ. Ind. Bot. Soc.*, 1933, **12**.

surrounding cells. Thus internal vascular strands carrying on their independent growth are differentiated. With the continued growth of the axis and without the cessation of the activity of the normal cambium more and more strips of secondary cambium appear in the rest of the xylem formed from the primary and secondary cambiums. The continued growth of the wood parenchyma ultimately splits the vascular cylinder into numerous irregular strands in a manner similar to that found in many lianes, *e.g.*, *Bauhinia*, etc. This type of structure is generally considered to be correlated with the habit of lianes, but here it is found in just a reverse type of plant—a species with a very stunted stem.

PRAKASH CHANDRA JOSHI.

Botany Department,
University of the Punjab,
Lahore,
January 2, 1935.

A Note on the Occurrence of a Smut on Two Indian *Selaginellas*.

THE occurrence of a fungous disease on the Peteridophytes is a comparatively rare phenomenon. In October, 1932, we collected two species of *Selaginella*, *S. chrysocaulos* Spr. and *S. chrysorrhizos* Spr., from Rajpur and Mussoorie respectively. On an examination of the material we found the presence of dark brown irregular patches on the leaves and stems of both the species. The fungus was at once identified as one of the Ustilaginales, but there was some difficulty in the generic determination. On referring to the previous literature on the subject we found that Mr. T. C. N. Singh[1] had already reported the occurrence of a species of *Entyloma* (?) on *S. chrysocaulos*, the material of which had been collected by Dr. B. Sahni while on his way back from Mussoorie to the Plains. From an examination of some of this material, kindly sent to us by Prof. Sahni, we think that the two forms are identical. The identification of the genus is still a matter of some doubt and will probably remain so till the spores have been germinated, but judging from the sorus and spore morphology it bears greater resemblance to *Melanotænium* than to *Entyloma*. One of the differences mentioned between the two genera is the presence of highly coloured to brownish spores in *Entyloma*, while those of *Melanotænium* are of a distinctly darker shade.[2] As reported by Singh, hyphæ are not of frequent occurrence, but in our material (some of which had younger sori) we often came across the more or less finger-like haustoria present in the cells of the host.

In conclusion, we wish to offer our sincere thanks to Dr. E. J. Butler, of the Imperial Mycological Institute, Kew, for having given us the benefit of his advice with regard to the identification of the fungus.

P. MAHESHWARI.
VISHWAMBHAR PURI.

Agra College,
Agra,
December 27, 1934.

[1] Singh, T. C. N., "A note on the occurrence of a smut on *Selaginella chrysocaulos*," *New Phytol.*, 1930, **29**, 294-296.

A Virescent-White Mutation in Rice.

IN the early strain of Kolamba, K 79, a seedling with white leaves was discovered last season. As the seedling displayed unique appearance it was potted off and reared carefully. Periodic examination of the growth of the seedling showed that the new leaves were invariably devoid of chlorophyll presenting whitish appearance, but very gradually changing to greenish colour, the colour developing from tip downward. The seedling was normal in fertility.

During the current season about 400 seedlings of the white mutant were raised and all of them were like the original plant. In due course a number of seedlings of the mutant and the normal parent strain were transplanted in the field for agronomic comparison. The results are as below:

Character	Mean No. of days to flower from sowing	Mean height of plants cm.
K 79 ..	90·96±0·30	118·58±1·28
Mutant ..	95·66±0·62	82·25±2·90

Character	Mean Panicle length cm.	No. of tillers	Mean yield per plant gm.
K 79 ..	28·75±0·32	5·83±0·18	19·04±0·76
Mutant ..	19·46±0·78	2·50±0·25	2·51±0·34

[2] Clements and Shear, *The Genera of Fungi*, New York, 1931.

It will be seen that the virescent-white plants are inferior to K 79 in panicle length, height, number of tillers and in yield, although they are late by about five days. The differences in all cases are highly significant. The slow growth of the virescent-white plants is due to very slow rate of chlorophyll formation. Colourmetric readings show that the mutant plants have about 66 per cent. chlorophyll compared to K 79.

The writer is not aware of any previous report of this type of chlorophyll mutation in rice, although albino, yellow and striped chlorophyll mutations have been reported.

The new type has been crossed with the parent K 79 to determine the mode of inheritance.

B. S. KADAM.

Rice Breeding Station,
Karjat, Kolaba,
November 1934.

On the Increase of Mutation Frequency following Inter-Specific Hybridization in *Nicotiana*.

By Prof. Dontcho Kostoff,

Institute of Genetics, Academy of Sciences of U.S.S.R., Leningrad.

THE hybrids produced between *Nicotiana Sanderæ* ($n=9$) with certain other far related *Nicotiana* species often formed some white stripes in the flowers. Every year for the last eight years I raised *N. Sanderæ* with various flower colours (whitish, pink, red, and the like, of the various intensities of red-violet colours), and have seen this species growing in many gardens, but only three times have I seen the kind of stripings as those observed in some of its F_1 hybrids.

The red flowering *N. Tabacus* var. *sanguineæ* ($n=24$) behaves in some crosses like *N. Sanderæ*. It has blood-red flowers.

In the crosses of the red flowering *N. Sanderæ* and *N. Tabacum* with the white flowering species [*N. alata* ($n=9$), *N. sylvestris* ($n=12$), *N. suaveolens* ($n=16$), *N. noctiflora* ($n=12$), *N. Tabacum alba* ($n=24$), etc.] and with greenish-yellowish flowering ones [*N. rustica* ($n=24$), *N. paniculata* ($n=12$), *N. Langsdorffii* ($n=9$), *N. glauca* ($n=12$)], red behaves like a dominant. in some combinations, however, incomplete dominance occurs too.

The stripings that appear on the F_1 hybrids usually affect single flowers. They appear with one or more than one white stripe on the red or pink background, or with pink stripes on a red background. The size of the affected areas vary very greatly. The largest white area I found was about 1 sq. cm. covering about 1/6 of the whole corolla (five petals), while the smallest ones represent only a small group of several cells. Sometimes we found red spats or stripes (reverse mutations) in the region of the white ones. Some flowers have only one stripe, while others have more than sixty (Fig. 1). The more detailed observations made on several hybrids are summarised in Table I. Other hybrids are not studied in detail.

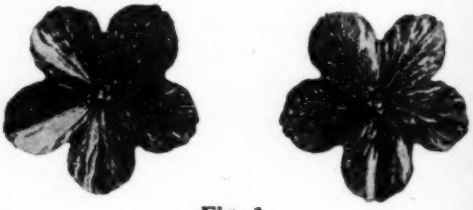

Fig. 1.

Striped flowers from a hybrid *N. noctiflora* × *N. Sanderae.*

It should be mentioned here that *N. Sanderæ* plants are often heterozygous and some of the F_1 hybrids, where *Sanderæ* participates, differ to a certain extent. Different genotypes of *N. Sanderæ* do not show the same degree of variegations. The most striking results were produced in some of the crosses between *N. noctiflora* (from the Harvard University, syn. *N. Cavanilesii*) and red flowering *N. Sanderæ*. Drawings of two extreme types are given in Fig. 1. We have the impression that the older hybrids have many more striped flowers, and the affected areas are much greater in the older hybrids than in the younger ones.

The stripings of the hybrid *N. Tabacum* var. *sanguineæ* × *N. alata* (white flowering) usually represent pink stripes on the red (reddish) background. But it was found

TABLE I.

No.	Maternal species	Flower colour of the maternal plant	Paternal species	Flower colour of the paternal plant	Flower colour of F_1 hybrids	Number of the flowers of F_1 studied	Number of the flowers of F_1 with one stripe	Number of the flowers of F_1 with two stripes	Number of the flowers of F_1 with more than two stripes	Number of the flowers of F_1 with more than twenty stripes	Flowers with secondary (red) reverse stripes on the background of the primary (white) stripes (reverse mutations)	Special remarks
1	*N. Tabacum* var. *sanguineæ*. (n=24)	Carmin red	*N. alata* (n=9)	White (cream-like)	Red-pine	95	21	5	2	..	..	Some of them studied during the second year
2	*N. Rustica* var. *humilis* (n=24)	Greenish-yellowish	*N. Sanderæ* (n=9)	Red	Red	37	12	6	4	..	1 (+1 ?)	One doubtful
3	*N. paniculata* (n=12)	,,	*N. Sanderæ*	,,	,,	53	..	..	..	..	..	
4	,,	,,	*N. Sanderæ* but another genotype	,,	,,	32	2	1	..	..	..	
5	*N. noctiflora* (n=12)	White	*N. Sanderæ*	,,	,,	8	..	..	5	3	8	
6	*N. noctiflora*	,,	,,	,,	,,	6	1	..	..	..	..	Another hybrid
7	,,	,,	,,	,,	,,	5	..	1	3	1	4	,,
8	,,	,,	*N. alata*	White	White	21	..	..	..	..	..	
9	*N. Tabacum* var. *alba* (n=24)	,,	,,	,,	,,	about 30	..	..	..	..	..	

that a part of the pink stripes changed into white in 11 flowers out of about 75.

It should be noted here that species hybrids produced from white flowering species, formed only white flowers (*N. Tabacum alba* × *N. alata*, *N. Tabacum alba* × *N. sylvestris*, *N. noctiflora* × *N. alata*, *N. suaveolens* × *N. alata*).

Species hybrids of *N. Tabacum* produced with far-related species like *N. alata* and *N. Sanderae* show striping (many of them, but not all of them), while those produced with closely related species, like *N. sylvestris* (*N. Tabacum sanguineæ* × *N. sylvestris*) do not show any stripings. At least I have not observed such. It should be added here that *N. sylvestris* is very closely related to *N. Tabacum*; there are evidences that it has participated in the origin of *N. Tabacum*.

N. Tabacum crosses easily with many varieties of *N. rustica* (greenish-yellowish flowers) but no variegations were observed in the F_1 (*rustica* × *Tabacum*) hybrids. The latter cross easily with the parental plants (Kostoff, 1930)[1] and from such back-crosses triploids and chromosomal aberrants are produced, while the hybrids *N. Tabacum* × *N. alata*, *N. Tabacum* × *N. Sanderæ*, and *N. rustica* × *N. Sanderæ* cannot be crossed back either to the parental plants or to some other third species, and all these three hybrids produced striped flowers.

N. Sanderæ hybrids do not form striped flowers when the other component species are closely related to *N. Sanderæ*, as for example, in the crosses *N. Sanderæ* × *N. alata*, *N. Sanderæ* × *N. Langsdorffii*, *N. Sanderæ* × *N. longiflora* (n=10), *N. Sanderæ* × *N. plumbagenifolia* (n=10), etc., while the hybrids from the far-related species: *N. rustica* × *N. Sanderæ*, *N. Paniculata* × *N. Sanderæ*, *N. noctiflora* × *N. Sanderæ*, etc., do form striped flowers. The first two hybrids are fully fertile, the next two are partially fertile when crossed back to

[1] Kostoff, Dontcho, "Ontogeny, Genetics and Cytology of *Nicotiana hybrids*," *Genetica*, 1930, **12**, 33-139.

Sanderæ, while the last three are sterile. Only a single plant was produced after numerous back-crosses (*N. noctiflora* × *Sanderæ*) × *alata*, and it was a triploid one with 30 somatic chromosomes (12+9+9). A transitional hybrid seems to represent *glauca* × *Sanderæ* in this respect. Only a few times we have seen single stripes on the flowers of F_1 hybrids of these two species. When the F_1 (*glauca* × *Sanderæ*) is crossed back to *N. Sanderæ* or to *N. Langsdorffii*, hybrids are produced with difficulties.

The appearance of the white stripes on the species hybrid cannot be due to a loss of chromosome or chromosomes, because reverse changes from white to red occur too, and the normal chromosome numbers, characteristic for the hybrids, were counted in the pollen mother cells of F_1.

It should be noted here that stripings reported above on the species hybrids cannot be identified or mixed up with the variegations or stripings often caused by virus diseases. The cases here reported were observed on healthy plants. We have often observed variegations and stripings on the flowers of some of the red flowering segregates of *N. triplex* (the triple fertile hybrid, *Tabacum* × *sylvestris* × *Rusbyi*), caused by mosaic disease. But they differ in the appearance and the kind of distribution of the colour.

The observations here reported show that the dominant genes for colour in some species hybrids produced from relatively far-related species changes to their recessive allelomorphs (white) more often in the species hybrids than in the pure species. Reverse changes (mutations) occur, too, with relatively great frequency, *i.e.*, mutations from the recessive to the dominant type. The hybridization seems to produce new internal conditions in certain cross combinations, where a "stable" gene behaves like a "mutable" one (compare the mutable genes in *Delphinium* described by Demerec, 1931).[2]

The hybrids represent a new system in which the mutation rate proceeds with a different frequency from that in the original species. The same may be true for the species originating from hybridization, especially for the amphidiploid ones. The author is indebted to Dr. H. J. Muller for criticism and to N. Dogadkina for making the drawing.

Ecological Studies of Pink Bollworm (*Platyedra gossypiella*, Saunders).*

By M. Afzal Husain, M.A. (Cantab.), I.A.S., M. Haroon Khan, B.Sc. (London), A.R.C.S., and Nazir Ahmad, M.Sc.

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THE Pink Bollworm—a cosmopolitan pest of cotton—shows in the Punjab a peculiar variation in the density of its population. In the south-eastern, sub-montane and the central regions of the province it is so abundant as to be regarded a 'major pest', while in the Canal Colonies and the western districts—the main cotton-growing tracts—it is not a 'pest' and is, in fact, scarce. Evidently, therefore, an abundant supply of its favourite food—the cotton crop—is not the only factor which determines the density of its population.

During the last few years an attempt has been made to analyse the factors which influence the incidence of this pest, in the Punjab. It has been determined that at Rohtak, situated in the south-eastern Punjab—a region of high incidence—the number of eggs laid by *P. gossypiella*, under natural conditions, throughout the period of its activity, is much higher than at Lyallpur, situated in the Canal Colonies—a region of low incidence. Thus at Rohtak during July, when the attack normally starts, the average number of eggs laid per female, based on the figures of three years (1931-33), varied from 13 to 49, while at Lyallpur this number varied between 2 and 7 only. The maximum number of eggs laid by a female was 326 at Rohtak and only 75 at Lyallpur. Later in the season too, during August, September and October, the average oviposition at Rohtak varied between 30 and 89, and at Lyallpur between 3 and 61 (only once in three years it went to 61, otherwise it was never above 40).

* The researches carried out are being financed by the Indian Central Cotton Committee. The generosity of the Committee is gratefully acknowledged.

[2] Demerec, M., "Behaviour of two mutable genes of *Delphinium Ajacis*," *Jour. Genet.*, 1931, **24**, 179-193.

Under experimental conditions it has been established that temperature, acting on the pupæ and the adults, largely determines the egg-laying of these moths. It has been determined that the optimum temperature for the full development of the gonads and the maximum deposition of eggs ranges between 75°–82° F. Thus the moths emerging from the pupæ kept at 75° F.—a favourable temperature—and exposed to the same temperature, gave on an average 98 eggs per female, but the moths bred under similar condition of temperature and kept at 95° F. —an unfavourable temperature—on an average laid only 23 eggs. On the other hand, the moths emerging from the pupæ kept at 92° F.—an unfavourable temperature—and exposed to the same temperature, hardly laid an egg, and even when exposed to a favourable temperature—75° F.—gave no more than 7 eggs per female.

Further, it has been found that over 80% of the moths emerging from the pupæ kept at a temperature of 92° F. or above, have not the capacity of procreation. The reason for this is that the males bred at such high temperatures, although otherwise normal, are devoid of fully developed sperms and hence incapable of fertilising the females.

The influence of humidity has not been so thoroughly worked out, but the results obtained show that it influences oviposition in much the same way as temperature. A high relative humidity, about 70·95%, has been found to be very favourable for the development of the gonads and the deposition of eggs.

On the basis of the results obtained under controlled conditions, a correlation between the biotic potential and the environmental resistance, *i.e.*, between the initial capacity for increase in numbers possessed by this insect and the resistance offered by temperature and humidity, under natural conditions, has been established. A study of the three years' meteorological data which, unfortunately, are very incomplete for an ecological investigation, has shown that oviposition was highest when the mean maximum temperature acting on the pupæ and the adults was about 90° F., the mean minimum 72° F. and the relative humidity 70% or over at 8 hours.

In places where the incidence of attack is high, the temperature and humidity, during the main period of the activity of the pest—July to October—approximate closely with those favourable for procreation, while in the Canal Colonies and the western districts, where the pest is present in insignificant numbers, both the maximum and the minimum temperatures are much higher and the humidity much lower. These adverse climatic conditions increase the sterility of the males on the one hand, and interfere with the process of egg-laying by the females on the other, thereby limiting increase in numbers. It is not, therefore, as one would imagine, only through the destruction of the individuals born that population is restricted, but perhaps, the restriction in the numbers of the individuals produced is more important. In other words, nature besides being 'red in tooth and claw' also controls birth.

The results obtained afford a basis for forecasting the intensity of Pink Bollworm attack in any particular region. To be able to do so, however, the meteorological conditions during the cotton-growing season and the time at which the moths emerge from the 'long-cycle', *i.e.*, hibernating larvæ should be fully known. If the emergence of moths coincides with the fruiting of cotton, and the climatic conditions are favourable for their procreation, then the pest will be serious, as is the case in Egypt, Mexico, Texas and the United Provinces of India. If, on the other hand, the emergence coincides with the fruiting of cotton but the climatic conditions are unfavourable, as at Hyderabad (Sind), the Canal Colonies and the Western Punjab, then the progeny of this pest will be limited in numbers and it will not become serious. At Surat (Bombay) and Wad Medani (Sudan) where the emergence takes place before the fruiting of cotton and most of the progeny destroyed because food is not available, the pest cannot be serious. Lastly in Kenya, Italian Somaliland and Coimbatore (Madras), where the pest remains active throughout the year it will not be serious because most of its progeny would be destroyed during the non-cotton season when the food supply is limited only to the few alternative host plants.

This short note is contributed to stimulate ecological research in this country, as research on these lines provides a sure foundation for scientific pest control.

The Hyolaryngeal Apparatus of Pelobatidæ.

By L. S. Ramaswami,

Department of Zoology, University of Mysore, Central College, Bangalore.

I HAVE recently been examining the cranial anatomy of *Pelobatinæ*, *Megalophrynæ* and *Sooglossinæ* when through the courtesy of Dr. G. K. Noble, I came into possession of a male specimen of *Scaphiopus hammondii*.* It appeared to me that an examination of the morphology of the larynx of this batrachian might reveal certain features not hitherto recorded, and this note gives a brief account of the topographical relations of the different cartilaginous elements of the larynx of *Scaphiopus* with one another and with those of the hyoid apparatus. On referring to the available literature on the subject of the Anuran larynx, I find that G. A. Boulenger[1] while giving a brief reference to the hyoid apparatus of *Scaphiopus solitarius* in his paper on the anatomy of this anurous amphibian makes no allusion to the structure of the larynx. I have carefully examined the larynx of *Scaphiopus hammondii* sent to me by Noble, and I notice that the hyolaryngeal apparatus of this species differs from that of the other allied forms such as, *S. holbrookii*,[2] *Pelobates fuscus*,[3] *Megalophrys nasuta*,[4] *M. montana*,[4] *M. hasseltii*,[4] *M. feæ*,[5] and *M. bœttgeri*,[6] in material points. I am indebted to the authorities of Raffles Museum, Singapore and of the Indian Museum, Calcutta, for specimens of *Megalophrys nasuta* and *Megalophrys major* respectively which I have studied for purposes of comparison. I take this opportunity of thanking Dr. Noble for his kind presentation of a specimen of *S. hammondii*.

The hyoid of *S. hammondii* offers certain points of anatomical interest and as Noble[2] makes no reference to this structure in his description of *S. holbrookii*, I am unable to compare the hyoid of these two species. The anterior processes of the hyoid in *S. hammondii* do not meet in the median line as in the case of *Pelodytes*,[7] but stand well apart with a wide median space between the processes. In other respects the hyoid of *S. hammondii* conforms to the general plan of this structure in the species examined of the family *Pelobatidæ*. If this apparatus of *Pelobatinæ* is compared with that of *Megalophrynæ*, we notice that the presence of a conspicuous foramen laterale at once distinguishes the former from the latter. In this connection it may be remarked that the figure of the hyoid of *Peloba'es fuscus* as given by Parker[3] does not reveal the presence of a foramen laterale; on the other hand Ridewood[7] who has described the same structure prominently figures it. Finally, I may observe that *Scaphiopus*

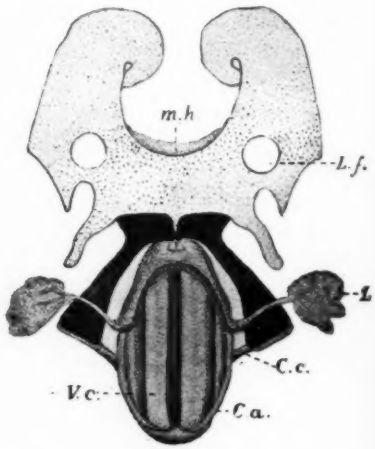

Fig. 1.

Hyolaryngeal apparatus of *S. hammondii* (♂). × 3.

c. a.	Cricoid annulus.
c. c.	Cartilaginous connection between the cricoid annulus and the epiphysis of the posterior cornu.
L.	Portion of the lung.
L. f.	Foramen laterale.
m. h.	Membrane.
v. c.	Vocal cord.

* Specimen from American Museum of Natural History, N. Y., No. 19637.

[1] Boulenger, G. A., *Proc. Zool. Soc. Lond.*, 1899, 793.

[2] Noble, G. K., *The Biology of the Amphibia*, McGraw and Hill. New York and London, 1931.

[3] Parker, W. K., *Phil. Trans. Roy. Soc. Lond.*, 1881, **172**, 1.

[4] Beddard, F. E., *Proc. Zool. Soc. Lond.*, 1907, 871.

[5] Beddard, F. E., *Proc. Zool. Soc. Lond.*, 1911, 393.

[6] Frazier, M., *Journ. Morph. and Physiol. Phil.*, 1924, **39**, 285.

[7] Ridewood, W. G., *Proc. Zool. Soc. Lond.*, 1897, 577.

hammondii resembles the other allied genera in having a reduced hyale and in the bony cornu bearing a fairly well-developed cartilaginous epiphysis.

In a recent paper[5] on the Anuran larynx, Miss Trewavas while describing the vocal organs of *Megalophrys robusta* gives a review of the previous work on this structure in the family *Pelobatidæ*. She generalises that "the most characteristic feature of the larynx is the incompleteness mid-dorsally of the cricoid ring". Moreover in the majority of the anurous forms belonging to this family which have been described, the two œsophageal processes given off from the cardiac end of the cricoids have been noticed. In some species, however, such as *Pelobates fuscus* and *Megalophrys hasseltii*, the larynx is shown by Blume[9] and Beddard[4] respectively without these œsophageal processes. Further, Noble in his book on "The Biology of the Amphibia" gives a figure of the larynx of *S. holbrookii* (p. 169), and indicates the presence of these œsophageal processes but does not mention the sex of the animal investigated by him. From his figure of *S. holbrookii*, the cricoids can be made out to be incomplete, thus conforming to the generalisation of Trewavas alluded to above.

In the specimen of *S. hammondii* examined by me the larynx presents certain structural features which differ from that of other examples investigated by the previous workers. In the first place, the cricoids of *S. hammondii* meet mid-dorsally and fuse to form a complete annulus. A second point of equal interest is the absence of œsophageal processes from *S. hammondii* which occur almost as a rule in *S. holbrookii*, *M. robusta*, *M. nasuta*, *M. montana*, *M. feæ*, *M. bœttgeri* and possibly also in *Sooglossinæ*. In this negative feature, *S. hammondii* resembles *Pelobates fuscus* and *M. hasseltii*. In addition to these interesting characteristics, *S. hammondii* presents a third feature which has not been noticed by the previous investigators in any of the related forms studied by them except in *Pelobates fuscus*.[9] This refers to a cartilaginous process given off from either side of the cardiac end of cricoid annulus which meets and fuses with the epiphysis of the bony posterior cornu of the hyoid. With such attachments to the hyoid, the larynx becomes difficult to be detached. I should point out that in the closely related species *S. holbrookii*, these connections have not been noticed by Noble.[2] The cartilaginous rod connecting the cricoid with the posterior cornu of the hyoid has been noticed in species of *Bufo*, *Pseudopaludicola*, *Oriophrynella* and *Dendrobates*.[8]

I am unable to say whether the presence or absence of œsophageal processes of the cricoid is a sexual feature, for the example I have investigated is a male form. In the family Ranidæ[10] the "spina œsophagea" of Gaupp occurs only in the female specimens and the male examples are usually devoid of them. When I drew the attention of Dr. Noble to these marked deviations of *S. hammondii* he wrote to me that he will reinvestigate the material and publish a comprehensive account of the several species of *Scaphiopus*.

Regarding the œsophageal processes of the larynx, I have to point out that *Megalophrys major* [*M. gigas* (Jerdon), *M. major* (Boul)] though agreeing with the other species of this genus in all essential points of the hyolaryngeal apparatus, differs in this important particular, *viz.*, the œsopha-

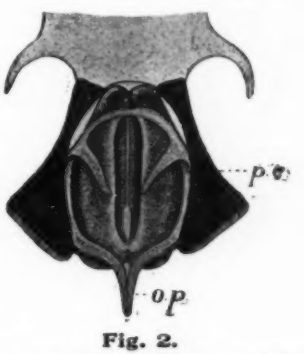

Fig. 2.

The larynx of *Megalophrys major* (♂) and a part of the hyoid apparatus. × 3.

o. p. Oesophageal process.
p. c. Posterior bony cornu of the hyoid.

geal processes have fused posteriorly so as to form a definite secondary annulus.

Miss Trewavas[8] summing up her observations on the hyolaryngeal structure of *Pelobatidæ* (p. 501) writes "a combination of

[8] Trewavas, E., *Phil. Trans. Roy. Soc. Lond.*, 1933, **222**, No. 401.

[9] Blume, W., *Gegen. Morph. Jahrb.*, 1930, **65**, 307.

[10] Ramaswami, L. S., *Half-Yearly Journ. Mys. Univ.*, 1932, **6**, No. 1, 32.

the following three characters in this apparatus appears to be diagnostic of the family: arytenoid without apical cartilage; cricoid ring incomplete dorsally; hyalia more or less reduced." I agree with her in regard to the first and the last features. From my examination of *S. hammondii* I should modify the second diagnostic feature and state thus: "the cricoid ring is incomplete dorsally except in *S. hammondii* (male)." It would be extremely interesting to examine both sexes of all the species of this genus and also the female form of *S. hammondii*.

Typhoons and Indian Weather. *

By V. Doraiswamy Iyer.

IT was generally thought by early workers on Indian Meteorology that all storms in the Bay of Bengal were formed in the Bay itself. Three storms which entered the Bay of Bengal from the Gulf of Siam in the years 1888 to 1897 led to a modification of this view at the beginning of this century. Two of these, the Port Blair cyclone (November 1891) and the Chittagong cyclone (October 1897), were shown to be continuations of China Sea typhoons by the Rev. Father Algue of the Philippine Weather Bureau. During subsequent years several storms were recognised to have entered the Bay of Bengal from the east, but no systematic attempt had been made to trace them eastwards. The present writer took up this investigation in 1924, and owing to the exigencies of other duties the work was completed only recently.

The typhoons of the western North Pacific Ocean and the China Sea may be divided broadly into two classes, namely, (1) those that, after travelling some distance westwards, recurve either in the sea or near the coast of China to the north and north-east and travel towards Japan; they would consequently have no influence on Indian weather, (2) those which travel in a westerly direction throughout their path in the Pacific Ocean and the China Sea and cross the coast of South China or Indo-China.

The typhoons of the second class recorded between the years 1881 and 1930 are 367 in number; they were examined with a view to find out how many of them had affected weather in India. It is well known that when a travelling cyclone crosses a mountain the cyclonic circulation up to the height of the mountain is cut off leaving a truncated cyclone in the upper air. This cyclonic circulation in the higher regions is transmitted to lower layers on the other side of the mountain, and if the air on that side has suitable conditions of temperature and humidity, the cyclone revives. Otherwise it dies. The process of revival, however, takes time and the cyclone becomes recognisable at the surface only after it has travelled some distance away from the mountain.

The examination revealed that as many as 128 of the typhoons had definitely an influence on Indian weather. Some of them redeveloped into storms or depressions, while others were recognisable only as low pressure waves associated with an increase of rainfall.

A monthly analysis showed that typhoons do not affect the weather in India in the first five months of the year. The few that do so in June are felt only in Burma and Assam. The chief typhoon months are July to November. During July and August as well as in November about a third of the westward moving typhoons affect weather in India, while in September and October nearly 50 per cent. do so. Most of those that come over in the months September to November develop into storms or well-marked depressions.

Looked at from the aspect as to how many of the storms and depressions that occur in the Bay of Bengal have a far eastern origin and are the sequels of typhoons or depressions of the China Seas, we find that the ratio of such storms to the total number in the Bay is one to nine in the months of July and August, one to four in September, one to three in October and one to six in November.

An examination of the tracks of the residual flows over the Indo-Chinese Peninsula with reference to the general circulation both at the surface and in the upper air indicates that they travel with the equatorial easterlies along the climatic front between the moist monsoon current from the south and the dry land winds from the north.

In the months of July and August this front is near Lat. 25°N., as the strong monsoon current, 4 to 5 Km. deep, flows as a southerly or south-westerly current up to this latitude; at greater heights the southerly current is replaced by the equatorial easterlies which also extend to about 25°N. in these months. The typhoon tracks over the Indo-Chinese Peninsula lie between Lat. 20° and 25°N. With the commencement of the retreat of the monsoon in September this front is displaced southwards and there is a corresponding displacement of the belt of tracks of the typhoons over the Indo-Chinese Peninsula, which now lies between Lat. 15° and 22°N.

The winter high over Asia develops in October and northerly winds extend further southwards, and push the front to lower latitudes. The belt of typhoon tracks over the Indo-Chinese Peninsula is also displaced further to the south and now lies between Lat. 10° and 20°N. With the intensification of the Asiatic High in November and the strengthening of the cold winds from the north the typhoon tracks in this month over the Indo-Chinese Peninsula lie between Lat. 15° and 10°N. The typhoons of October and November mostly recurve to the north and north-east in the east of the Bay; they apparently travel with the upper

* From the paper read at Colloquium at Meteorological Office, Poona, on 11th December, 1934.

air current within the first three kilometres and appear to be shallower than the typhoons of July and August. By December winter conditions become established in southern Asia and no typhoon crosses the Indo-Chinese Peninsula; occasional ones, however, travel westwards farther south in about Lat. 8°N.

It has been pointed out by Visher that, although typhoons attain destructive violence to the west of Long. 150°E., they are probably generated much further east as indicated by observations in recent years in the Marshall Islands and in the seas south of the Hawaii Islands. This is not improbable as the line of convergence of the south-easterly trades and the north-easterly trades lies well to the north of the equator in the typhoon months, and extends to the coast of Central America. The typhoons may well be regarded as pressure waves generated in this line of convergence, which travel westwards with the equatorial easterlies, and intensify when they reach more northerly latitudes on approaching the Asiatic continent. If we could draw the tracks of all these low pressure waves in all stages of development, it is probable that we would find that a majority of them have their origin in the East Pacific Ocean and finally recurve into the general westerly circulation of the temperate latitudes in the North Pacific Ocean, China or Upper India.

Research Notes.

Über Gewisse Orthogonale Polynome, die Zu einer Oszillierenden Belegungs-Funktion Gehören.

THE properties of some interesting polynomials arising in connection with Legendre's polynomials are treated in this paper (Szego, *Math. Ann.* B. **110**, pp. 501-513). At the same time Szego proves two conjectures of Stieltjes which remained unproved up till the present day. The polynomials that he considers are defined by means of the equation

$$\frac{1}{Q_n(x)} = E_n(x) + a_1 x^{-1} + a_2 x^{-2} + \ldots.$$

where $Q_n(x)$ as usual represents the Legendre's polynomial of the second kind. Then we have obviously the orthogonality relation

$$\int_{-1}^{+1} P_n(x) \quad E_n(x) \quad x^K dx = 0, \qquad (K = 0, 1, 2, 3, \ldots, n).$$

(Here it is to be observed that the weight-function $P_n(x)$ is highly oscillating.) The two conjectures of Stieltjes which he proves here are: (1) The roots of $E_n(x)$ are all real simple and lie in the interval $(-1, +1)$; (2) The roots of $P_n(x)$ separate those of $E_n(x)$. In this connection Szego remarks that a more general conjecture of Stieltjes is not yet proved and that his methods developed here cannot perhaps be applied to the general case. Some analogous results are also proved for $E_n^{(m)}(x)$ obtained in an analogous manner from the associated Legendre function of the second kind $Q_n^{(m)}(x)$.

K. V. I.

Über die Kleinsche Theorie der Algebraischen Gleichungen.

IN this very interesting article Brauer (*Math. Ann.*, Band, **110**, Heft IV, pp. 473-500) has perfected Klein's theory in many important directions. It is well known that Klein has established an intimate connection between the solution of an algebraic equation and the "Formen-Problem" of a group (usually the Galois group of the equation) which is given either as a linear transformation group or as collineation group. The Hermite-Kronecker solution of the quintic equation by means of a modular equation of the fifth order (the icosæder equation) was explained very clearly by Klein by means of this analysis. He and his students have contributed very largely to the theory of the sextic and the septic equation which can perhaps be considered as the most important work in this field since the classical work of Abel and Galois.

The "Formen-Problem" of a group of linear transformations (order n) is the determination of a point in the n-dimension space in which the linear transformations are supposed to act when the values of the fundamental invariants for the point are known. In an exactly similar manner we can formulate the same for a collineation group. The fundamental problem is that of determining the cases when the solution of an equation can be made equivalent to the "Formen-Problem" of a suitably chosen group (it is usually the Galois-group of the equation). In the case of the linear-transformation-group this problem is completely solved. In a very interesting way Brauer solves this problem for the case of collineation groups also. The first part of the article does not presuppose much knowledge

on the part of the reader but the latter part presupposes some knowledge of the theory of hyper-complex numbers and group characters.

It has already been observed by Klein that in the case of the quintic equation the solution can be reduced to that of the "Formen-Problem" of the icosæder group only if we extend the field of the coefficients by another quadratic irrationality. It has been found by Brauer that in general the extension of the field is indispensable; and the theory of hypercomplex numbers gives us much knowledge about the nature of the irrationalities that we have to adjoin. In § 1, 2, 3 he shews how the solution of an equation and the "Formen-Problem" of a collineation group can be related. The principal result that he proves is dependent upon the theory of factor systems of the representation of groups treated by Schur in *Math. Zeit.*, 1919, **5**. It is 'If $f(x)=0$ is an equation with coefficients out of a field P with its Galois-group G which is one-one isomorph with a collineation group C, then the complete solution of the equation is equivalent to a "Formen-Problem" of C if among the factor systems of C, a system is found which is associated with the unit system (in the sense of Schur, *loc. cit.*).' Here it is shewn that the number of those factor systems that are to be investigated is equal to the index of the group of the inner automorphisms of G with the group of all the automorphisms of G. In § 4 he connects the theory of the solution of the equation with an aggregate of simple normal algebras (or hypercomplex numbers) over P in an independent way. The principal results of § 4 and 5 are these.

There exist a finite number of normal simple algebras over P, which can be determined and which possess the following property—*viz.*, the complete solution of $f(x)=0$ is equivalent to a solution of a "Formen-Problem" if there exists a complete Matrix algebra among the previously mentioned finite number of them. If there does not exist any such algebra among them, then the field P is to be extended. If m is the smallest of the indices of the algebras over P, then the degree of the extended field P′ over P is at least equal to m. If n is the dimension of the space in which the collineations are supposed to act, then the degree of P′ over P cannot exceed $(n+1)$. The results are illustrated by taking the quintic, sextic and septic equations.

K. V. I.

Raman Effect of Cyclohexane.

K. HABERL [*Ann. der Phys.*, 1934, **21(5)**, 301] has found a remarkable fluorescence in the Raman spectrum of cyclohexane excited by Hg-radiation with a great temperature dependence. The regions of fluorescence are about 2,900 A. U. and 4,000 A. U. He has also found that the fluorescence disappears if the Hg-radiation is filtered through a glass plate. No explanation of the above phenomenon is yet given.

Experiments with Positrons.

IN *Zeitschrift für Physik*, 1934, **92**, pp. 485-512, E. Rupp gives a detailed account of the experiments conducted by him with the object of discovering the properties of the positron. His results agree in the main with those of other workers, particularly J. Thibaud, but the special interest of the work lies in the way in which the positrons were produced. In their first experiments on induced Radioactivity Curie and Joliot found that when aluminium was bombarded by α-particles it was changed to radio-phosphorus which emitted positrons. This has been utilised in the present work to obtain a source of positrons. Even the α-particles were produced in the laboratory by bombarding lithium by highly accelerated protons. The α-particles so produced then hit the aluminium and gave rise to positrons. A large number of experiments were conducted to determine the properties of these positrons. The value of e/m for the positron was found to be $0{\cdot}95 \pm 0{\cdot}05$ times that for the electron. The positrons when scattered by aluminium and gold foils showed no diffraction rings while electrons of the same energy do show such patterns. The absorption coefficients of Al, Cu and Au, for positrons were 30 per cent. smaller than for electrons. The loss of velocity was greater for positrons than for electrons when they traversed similar foils of Al. The positrons did not dislodge secondary positrons but liberated secondary electrons as efficiently as primary electrons do. The positrons excited a strong X-radiation whose wave-length was independent of the velocity of the positrons, while electrons produce X-rays whose wave-length does depend on the velocity of the electrons. In the mean each positron produced two quanta of X-radiation. The positrons were not

found to produce artificial transmutation of elements.

T. S. S.

The Production of Neutrons from Beryllium by means of hard X-rays and artificial Radioactivity.

In a recent communication published simultaneously in *Nature* (1934, **134**, 880) and *Die Naturwissenschaften* (1934, **22**, 839), A. Brasch, F. Lange and A. Waly of Berlin and T. E. Banks, T. A. Chalmers, L. Szilard and F. L. Hopwood of London describe experiments in which neutrons were liberated from beryllium by means of hard X-rays. The X-rays were produced by high-voltage electron tubes worked by a high-voltage impulse generator installed in the High Tension Laboratory of the A.E.G. in Berlin and capable of delivering several million volts. The X-rays produced from a tungsten anticathode in a tube working at 1·5 million volts fell on the beryllium. Bromoform was irradiated by the neutrons thus produced and when the radioactive Bromine isotope was isolated in London it was found to have an activity with a half-value period of six hours. The activity was increased when the voltage of the tube was increased to a value below two million volts. The activity showed a rapid increase with an increase in the voltage. This can be explained if there is a limiting wave-length for the X-rays which can liberate a neutron from beryllium, for the fraction of the total output of the X-ray tube, which is harder than this limiting radiation will increase rapidly with increasing voltage applied to the tube.

T. S. S.

The Genesis of Elements.

G. N. Lewis (*Phys. Rev.*, 1934, **46**, p. 897) has put forth an interesting hypothesis regarding the genesis of elements. All celestial bodies except those having the highest temperatures are supposed to consist mainly of the elements that are found in metallic meteors (mostly Ni and Fe) which are assumed to be thermodynamically most stable states with respect to transmutations amongst elements. But they become affected superficially by the action of radiation of the type of the cosmic rays or the much harder rays as are responsible for the so-called "bursts". This results in the formation of the lighter elements as are found in the earth's crust and the stony meteors. Less often the nuclei may combine to form the heavier elements. The disintegration of the nucleus under the action of radiation mostly takes place so that (*a*) an even splitting into two nuclei takes place, each having half the mass and half the charge of the original nucleus, or (*b*) a nucleus of the type "$4n$" is formed. Sometimes such processes yield a few unknown isotopes. These are assumed to be unstable and are supposed to undergo β-ray transformations producing the more stable elements.

By this hypothesis it has been possible to account for the nature and extent of occurrence of the more abundantly occurring elements in the earth's crust and the stony meteors. This supports the favourite theory of the petrologists that the interior of the earth consists of metallic masses resembling nickel steel.

K. S. G. D.

Platinum-Rhodium Alloys for Oxidation of Ammonia.

The catalytic oxidation of ammonia to oxides of nitrogen is from the standpoint of industry, one of the most important reactions in heterogeneous catalysis. The choice of a suitable catalyst and the conditions of economic operation have been the subject of a number of investigations. Two general types of commercial processes have been in use: (*a*) Those in which the operation is carried out at atmospheric pressure; (*b*) Those in which the reaction is conducted at high pressures. The choice of a proper catalyst is thus governed by the operating conditions. During the War, iron oxide catalyst with bismuth oxide as promotor was employed in Germany, but was subsequently given up in view of the low efficiency. Platinum in the form of fine gauze has been extensively used, but the loss of metal under the operating conditions is a factor which cannot be neglected. The optimum condition for the minimum loss of catalyst by disintegration, high conversion efficiency and large capacity under the actual conditions of commercial operation have been worked out by Handforth and Tilley (*Ind. Eng. Chem.*, 1934, **26**, 1287). They have shown that Platinum-Rhodium alloys containing 5-10% of Rhodium have been found to give a low loss of metal and

high capacity under the operating conditions required for the maintenance of high conversion efficiency. Thus at the same temperature (900°C.) the conversion efficiency of 10% Rhodium alloy is 99% while that of pure platinum is 95%. The loss in weight under similar conditions for the Platinum-Rhodium alloy is much lower than that for pure platinum. The results are of importance not only in industry, but also in the elucidation of the theory of promotor action.

M. P. V.

Observation on Spherulites.

A COMPREHENSIVE study on spherulites has been made by R. J. Colony and A. D. Howard (*Am. Mineralogist*, Nov. 1934, **19**, No. 11) from the rocks collected from various places in America. The point of interest is the distribution of microlites both within and around the spherulites. The microlites within the spherulites are arranged in a confused manner, while around the spherulites, they are bent and show a characteristic alignment. Experimental determination with menthol and pyroxene showed, that as long as the melt remained sufficiently liquid the microlites were borne toward the growing spherulite and the arrangement was haphazard. As the viscosity increased the movement became slower, and theoretical discussion has revealed that the fibres of microlites will curve around the spherulites. He has also observed the interesting phenomena of spherulites growing within spherulites, and after discussing the various alternatives, he suggests that the larger or the host spherulite started growing first, and when it included the smaller one the latter could not grow due to lack of supply of material, while the former became bigger and bigger due to continuous growth. From the experimental evidence and theoretical discussion he has concluded that at the time of emplacement the lava was sufficiently liquid, so that the microlites were disturbed by the diffusion currents set up in response to spherulitic growth. From this study he has shown that since there is a close relationship between viscosity and the rate of cooling, the arrangement of microlites in the spherulites may be used as an indication of the comparative rates of cooling of similar lavas.

Magmatic Wedge.

AFTER contributing a series of important papers on crustal mechanics J. S. DeLury has published a very interesting article (*Am. Journal of Science*, Nov. 1934, **28**, No. 167) on 'the magmatic wedge'. In this he has made a detailed study of the geothermal gradients and their relation to the development of magma in sub-crustal regions. In this connection he suggests that magmas are locally formed and locally intruded in contrast to huge vertical magma chambers. From the geophysical data available he has discussed the principle of hydraulic wedge and migration of magma with reference to solid flow. His conclusions have a direct bearing on such major problems of geology as continental drift isostasy and petrogenesis. In the end he suggests that assimilation in its broadest aspect would appear to be the controlling factor in the development of diverse rock types though some aspects of differentiation cannot be ignored. This is indeed a statement, which will revoke the controversy between the two schools, namely, the assimilation and differentiation. But, however, it is gratifying to note that a further contribution on this aspect of the question is under preparation and petrologists in particular will be watching with interest the publication of the same.

Liopelma Studies.

NO. 1. INNER EAR; NO. 2. CRANIAL CHARACTERS.

D. S. WAGNER in these two papers (*Anat. Anz.*, 1934, Bd. **79**, 51–64–65–112) amply puts forth evidences in favour of the erection of the group *Liopelmidæ* by Noble to accommodate Ascaphus and Liopelma. The *Liopelmidæ* lack a middle ear, annulus tympanicus plectrum and eustachian tubes. Only the operculum persists. The quadratomaxillary is also absent. The inner ear, however, does not suffer a parallel degeneration. Liopelma is linked with Ascaphus further in possessing separate passages for V and VII nerves, and a foramen acusticum medium. Thus the study of the otico-suspensorial region of the skull of Liopelma certainly affords corroborative evidence of he autonomy of the *Liopelmidæ*.

Science Notes.

New Year Honours.—The names of the following men of science are included in the list of recipients of the New Year Honours:—

C.I.E., Rai Bahadur Dayaram Sahni, Director-General of Archæology. *Knighthood*, Lt.-Col. T. N. Duggan, Grant Medical College, Bombay. *Dewan Bahadur*, Rao Bahadur S. E. Ranganathan, Vice-Chancellor, Annamalai University. *Rai Bahadur*, Rai Sahib Malik Charan Das, Secretary, Imperial Council of Agricultural Research Department. *Rao Bahadur*, Mr. G. N. Rangaswami Iyengar, Millet Specialist, Agricultural Research Institute, Coimbatore.

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We are happy to felicitate Rao Bahadur L. K. Ananthakrishna Ayyar, the veteran Anthropologist of India, formerly Professor of Anthropology, University of Calcutta, on his being nominated a Fellow of the French Academy. The Minister of Education in France has also presented Mr. Ayyar with the French National "Brevet" appertaining to "Officer D'Academie".

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Prof. M. W. Rosenthal has been appointed by the Mysore Durbar as Professor of Pathology, Medical College, University of Mysore, and Officer-in-charge, Sri Krishnarajendra Hospital, Mysore. His wife Dr. M. E. Rosenthal has been appointed Medical Adviser to the Women and Children Welfare Committee, Mysore.

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Prof. William Wright, Dean of the London Hospital Medical College, was on a short visit to India in connection with the preliminary examination of the Royal College of Surgeons. This was the first time the examination was conducted in India.

* * *

Cotton Research Studentships.—The Indian Central Cotton Committee will award in February 1935 two research studentships tenable for 2 years from April 1935. The studentships are of the value of Rs. 100 per mensem during the first year, and Rs. 120 per mensem during the second. One will be awarded in Botany (Cotton Breeding) and the other in Cotton Entomology (Cotton Pests) if suitable applications are received.

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Mr. T. L. Merriman, I.C.S., has been nominated a member of the Indian Lac Cess Committee, Imperial Council of Agricultural Research Department *vice* Mr. H. E. Horsfield resigned.

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Indian Science Congress, 1936.—According to a report appearing in *Statesman*, Dr. Sir Upendranath Brahmachari, Kt., M.D., Ph.D., F.A.S.B., has been elected President of the Indian Science Congress, 1936, which will be held at Indore in January 1936.

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Scientific Exhibition, Royal Institute of Science, Bombay.—It is not often that one can see in India, Scientific Exhibits and devices like those displayed at the Exhibition organised by staff and students of the Royal Institute of Science, Bombay, from the 13th to 18th December, 1934, in aid of the Bombay Hospitals under the patronage of His Excellency the Governor of Bombay and Lady Brabourne. In a country where occasions like these are not a regular feature on the programme of any Institution, the layman has a special interest in them, so long as they cater for his entertainment and satisfaction of curiosities. This is much more so on account of the absence here of permanent Institutions like Science Museums of Western countries. The visitors to this Exhibition evinced a great interest in the standing exhibits as well as manipulated devices shown in all the sections, *viz.*, Physics, Chemistry, Botany and Zoology. If the number that visited is any gauge of its success, we can safely say that the Exhibition had been very popular. The amount realised to the extent of about Rs. 13,000 will go towards the relief of sufferers in Bombay Hospitals.

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All-India Medical Conference.—An Exhibition was organised in connection with the Conference. Sir Fazl-i-Hussain in declaring the Exhibition open, remarked "India may well be proud, that things for which, she not very long ago, entirely depended on foreign countries, can now be supplied to an increasing extent by Indian Manufactures." The need for such exhibitions is great as the medical profession needs to be informed of the progress achieved in the manufacture of chemicals, drugs, apparatus and surgical instruments by different firms within and outside India. This will not only help to further the development of the indigenous industry but will also serve to take stock of the scientific contributions to Pharmacœpia made by Indian Research.

* * *

Advisory Board of Education.—One of the important resolutions that was passed at the general session of the All-India Educational Conference held during the last week of December at Delhi concerns the formation of a central body whose main function will be to co-ordinate educational activities of the various provinces and which will serve as a bureau of information in all Educational matters.

* * *

All-India Veterinary Conference.—The Eighth Session of the Conference was held at Bombay on the 29th and 30th December 1934, Khan Sahib N. D. Dhakmarwala presiding. In the course of his Presidential Address, the Khan Sahib stressed on the need for establishing a large number of animal welfare centres. The cash value of cattle, labour and dairy products is not less than 15,000 crores of rupees annually and the need for establishing such centres distributed throughout the country is imminent. There is also need for a Central Nutrition Institute to co-ordinate research work done in the Provinces. He referred to the vast unexplored animal wealth of the country and pointed out the possibilities of improvements in dairy and farm products.

* * *

Indian Institute for Medical Research.—The Institute was opened at Calcutta on the New Year Day in temporary premises at 41, Dharmatola Street. In addition to a diagnostic laboratory the research department of Bacteriology and Protozoology have started work. Other departments will be started shortly when more

suitable and commodious accommodation becomes available.

A Scientific Advisory Board with several eminent scientists of India has been constituted to advise the Institute on all technical matters.

* * *

Federation of National Educational Institutions in India.—With a view to bring together the various National Institutions imparting higher education scattered all over India, it is proposed to form a Federation of all the Institutions. With the co-ordinated efforts, a further expansion of National Education through the medium of the language of the country would result. More than fifty lakhs of Rupees have been spent in building up all these National Institutions and several lakhs are being spent every year for their maintenance and development. At present they are more or less isolated; each University has a curriculum of its own and the degrees conferred by one is not recognised by the others. A federation which would act as an inter-University organisation and bureau of information is now needed to further the cause of National Education in India. The draft constitution and rules of procedure have been circulated among all the Institutions and a preliminary conference for constituting the federation will be held in February next.

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Imperial Institute.—Sir Harry Lindsay, K.C.I.E., C.B.E., I.C.S., has been appointed Director of the Imperial Institute, London, with effect from 1st October 1934 *vice* Lieut.-Gen. Sir William Furse, K.C.B., D.S.O., retired.

Sir Harry Lindsay was Director-General of Commercial Intelligence, Calcutta, 1916-21 and Secretary to the Government of India, Commerce Department in 1922. He was appointed Government of India Trade Commissioner in London in 1923.

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Awards of the Royal Society, 1934.—The *Copley Medal* was awarded to Prof. T. S. Haldane in recognition of his discoveries in human physiology and of their application to Medicine, Mining, Diving and Engineering. (2) The *Rumford Medal* was awarded to Prof. W. J. de Haas for his researches on the properties of bodies at low temperatures and in particular for his recent work on cooling by the use of adiabatic demagnetization. (3) *Royal Medals* to Professor S. Chapman for his researches on the Kinetic Theory of Gases, in terrestrial magnetism and in the phenomena of the upper atmosphere and to Prof. E. D. Adrian for his work on the Physiology of Nerves and its application to the problems of sensation. (4) The *Davy Medal* to Prof. W. N. Hawworth for his researches on the molecular structure of carbohydrates. (5) The *Darwin Medal* to Prof. A. C. Seward in recognition of his work as a paleobotanist. (6) The *Sylvestar Medal* to Earl Russell for his distinguished work on the foundation of Mathematics. (7) The *Hughes Medal* to Prof. K. M. G. Siegbahn in recognition of his work as a physicist and technician on long wave X-rays.

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School for Polar Research, Cambridge.—According to a note appearing in a recent issue of "Science", a centre for Polar Research was opened by Stanley Baldwin on November 16, in the presence of several Arctic Explorers. This centre is designed as a memorial to Captain Robert Falcon Scott and the facilities of the building include a library, map room, museum and archives containing all available log books, diaries and weather records kept by Polar expeditions. "Arctic and Antarctic exploration is a prolonged war which needs strategy and carefully laid plans for its successful prosecution. The new building provides a venture in study and research for all those going out into the partly known and unknown."

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The Nobel Prize for Chemistry has been awarded to Dr. Harold C. Urey, Professor of Chemistry at Columbia University, for his discovery of deuterium.

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In view of the large growth of the Indian Sugar Industry, large quantities of molasses are now available; last year the quantity produced amounted to 500,000 tons. It is estimated that this year it will amount to 650,000 tons, which the United Kingdom and a British Company has already undertaken to purchase with a view to turn them into manure. The Calcutta Port authorities as well as the railways have consented to give special rates for the export of molasses, which will prove a great boon to the sugar industry, utilising, as it does, a hitherto wasted byproduct. (*Chemical Age.*)

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On Forecasting Weather over North-East Baluchistan during the Monsoon Months July and August.—By A. K. Roy and R. C. Bhattacharya (Indian Meteorological Department, Scientific Notes, Vol. V, No. 58).—The difference between barometric pressures at 0700 hrs. local time at Khanpur (in the south Punjab) and Rawalpindi (in the north Punjab) is a useful factor in predicting weather over north-east Baluchistan during the two months July and August. A statistical examination of data for five years (1929-1933) confirms the belief that the days on which the pressure difference (Khanpur *minus* Rawalpindi) is negative are usually associated with disturbed weather, and the days with positive difference are generally fine. It is found that a forecast based on the single criterion would be correct on about 69 per cent. days. The results are extremely striking when the days with large negative and positive differences are taken into consideration. It is found that out of 33 days during the above period when the difference of pressure at 0800 hrs. I.M.T. on any day was 0·10″ or more, rainfall was recorded during the next twenty-four hours on as many as 29 days at one or more of the five observatories in north-east Baluchistan while measurable rain occurred only on 1 out of 54 days associated with a positive difference amounting to +0·05″ or above.

* * *

Mechanical Testing of Timber.—(His Majesty's Stationery Office. Price 1*s.* net. Post free 1*s.* 1*d.*) Anyone desiring to determine the mechanical and physical properties of timber from tests on small clear specimens will be interested in the Report of the Committee on the Mechanical Testing of Timber. This Report is the result of a critical examination into existing standard methods of the mechanical testing of timber in the form of small specimens free from defects. The

conclusions arrived at are constructive and certain recommendations are made concerning existing practice. The report is fully illustrated with diagrams and photographs.

* * *

The Physiological Society of India.—A society, named "The Physiological Society of India," has been started in Calcutta in July, last year, and has been registered in December. This Society aims at promoting and organising researches in Physiological and Bio-chemical problems of India by enlisting the co-operation of Physiologists and Biochemists working in the various laboratories of India and also of those scientists and medical men who take an interest in these two basic medical sciences. The Society had already arranged four ordinary meetings in which several important contributions by research workers were discussed. The office-bearers of the Society are :—

President.—S. C. Mahalanobis, Esq., B.Sc. (Edin.), F.R.S.E., I.E.S. (Retd.), Professor of Physiology, the University of Calcutta and Carmichæl Medical College, Calcutta. *Vice-Presidents.*—(1) Sir Nilratan Sircar, Kt., M.A., M.D., D.C.L., LL.D., formerly Vice-Chancellor, Calcutta University. (2) Sir Kedarnath Das, Kt., C.I.E., M.D., F.C.G.G., Principal, Carmichæl Medical College, Calcutta. (3) Sir Upendra Nath Brahmachari, Kt., M.A., M.D., Ph.D., Professor of Tropical Medicine, Carmichæl Medical College. Calcutta. (4) Dr. Bidhan Chandra Roy, M.D. (Cal.), M.R.C.P. (Lond.), F.R.C.S. (Eng.), Professor of Medicine, Carmichæl Medical College, Calcutta. (5) Dr. H. E. C. Wilson, Professor of Bio-Chemistry, All-India Institute of Hygiene and Public Health. *Secretaries.*—(1) N. C. Bhattacharji, Esq., M.A., B.Sc., Professor of Physiology, Presidency College, Calcutta. (2) N. M. Basu, Esq., M.Sc., Professor of Physiology, Presidency College, Calcutta. *Asst. Secretary.*—Dr. P. N. Brahmachari, M.Sc., M.B., F.R.S. *Treasurer.*—Dr. B. B. Sarkar, D.Sc. (Edin.), F.R.S.E., Professor of Physiology, University of Calcutta. The Executive Committee of the Society consists of the above office-bearers and eleven other members representing various institutions.

* * *

The Indian Botanical Society.—The following resolutions were passed at the Annual Meeting of the Society held in Calcutta on the 4th January 1935:—It has come to the knowledge of the members of the Indian Botanical Society that a proposal is under consideration for the removal of certain irreplaceable Botanical specimens of great scientific value, including type-specimens, hitherto preserved in the Herbarium of the Royal Botanic Gardens, Sibpur (Calcutta). This body views the proposal with serious apprehension, realising, as it does, that the removal of any such specimens is bound to be detrimental to the progress of research in systematic Botany in India. It is strongly opposed to the removal from this country of any specimens except one out of a triplicate set (not being a type specimen) for purposes of *temporary* loan or exchange.

2. This body is further of opinion that in the interest of Botanical Research in India it is imperative for the Botanical Survey:

(*a*) To frame and enforce strict rules as is done by the authorities of Kew Herbarium, the British Museum, the Indian Geological Survey and the Indian Zoological Survey, for controlling the loan or exchange of specimens.

(*b*) To prevent all further transfers of types and co-types *under any circumstances*.

(*c*) To demand the return to India of all type-specimens belonging to the Botanical Survey previously sent abroad either on temporary or permanent loan.

3. This body understands that the question of removal originated during policies of retrenchment when dangers to historic collections in general were agitating the minds of scientists. This body places on record the opinion that considerations of economy should not be allowed to stand in the way of the preservation within the country of original specimens of scientific value, which constitute a national asset.

4. This body therefore strongly urges the Government of India to provide the necessary facilities for the adequate housing and preservation in this country of the specimens in question.

5. This body also recommends that the Government of India may be pleased to restore, if possible, the two posts retrenched from the Botanical Survey.

6. This body resolves that the above resolutions be communicated to the Government of India and to the Government of Bengal.

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Back Numbers of the Biochemical Journal.—Back volumes of the Biochemical Journal, Volumes 15 to 27 (1921-1933) and Index to Volumes 11-20, are available for sale. The first four volumes (1921-1924) are bound. Enquiries regarding the purchase of the same are invited. Apply to "B.J." *C/o. Current Science*, Indian Institute of Science, Hebbal P.O., Bangalore.

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We acknowledge with thanks the receipt of the following :—

"Actualites Scientifiques et Industrialles," Nos, 159, 160, 165, 177, 180, 181, 182, 183, 185, 186, 187.

"The Journal of Agricultural Research," Vol. 49, Nos. 6 & 7.

"The Proceedings of the Association of Economic Biologists," Vol. I (1930-1933).

"The Biochemical Journal," Vol. 28, No. 5.

"The American Journal of Botany," Vol. 21, No. 9.

"The Journal of Institute of Brewing," Vol. 40, No. 12, December 1934.

"The Canadian Journal of Research," Vol. 2, No. 5.

"The Chemical Age," Nos. 804-807.

"Berichte der Deutschen Chemischen Gesellschaft," Vol. 67, No. 12.

"The Journal of Indian Chemical Society," Vol. 11, No. 11.

"The Experimental Station Records," Vol. 71.

"Forschungen and Fortschritte," Jahrgang 10, Nos. 31, 33, 34, 35 and 36.

"Indian Forest Records," Vol. 20, Nos. 12 & 14.

"Indian Trade Review," Vol. 12, Nos. 71 & 72.

"Monthly Statistics of the Production of Certain Selected Industries of India," No. 6 of 1934-35, September 1934 (Government of India Publication).

"Advance Proceedings of the Asiatic Society of Bengal," Vol. 1, No. 3.

"Bulletin of the Academy of Sciences of the United Provinces of Agra and Oudh, Allahabad, India," Vol. 3, Nos. 3 & 4.

"Proceedings of the Academy of Sciences of the United Provinces of Agra and Oudh, Allahabad India." Session 1934-35, Pt. 1, Vol. 4.

"Mathematics Student," Vol. 2, No. 3.

"Medico-Surgical Suggestion," Vol. 3, No. 11.

"Meteorological and Scientific Notes," Vol. 5, No. 8.

"Nature," Vol. 134, Nos. 2396-2398.

"Natural History," December 1934.

"The Journal of Nutrition," Vol. 8, No. 5.

"The Russian Journal, Tome IV (66), Nos. 4 5 and 6.

"The Review of Scientific Instruments," Vo 5, No. 11.

"The Indian Trade Journal," Vol. 115, No 1487-1489.

Reviews.

THE DRAMA OF WEATHER. By Sir Napier Shaw. (Cambridge University Press.) Price 7*s*. 6*d*.

The English-reading public owe a deep debt of gratitude to the dozen of British meteorologists and the author of the four volumes of the *Manual of Meteorology* for this eminently readable little book on Meteorology.

In a small space of 270 pages, Sir Napier has treated the sequence of events taking place in the sky and constituting weather as the progress of a great drama. The stage is the whole atmosphere, the actors in the drama are the clouds, rainbow, lightning, water spouts, dust-storms and weather phenomena. Some of the jewellery of the actresses such as the beautiful ice crystals constituting snow, come in for detailed description. The qualifications of the watchers of the play, namely, the observers, and their equipment which is the instruments of a meteorological observatory, are then attractively described. The recounting of the story of the weather by the watchers and their attempts at finding the leading motives of the author of the play are told in the next chapter. Sir Napier's great skill in compressing a vast amount of material in the form of well-chosen and original diagrams and tables is exceptionally well seen in this chapter. The periodic phenomena of the weather, the rhythm of the atmosphere, is shown by the diurnal and seasonal variations. Besides rhythms which any one can see, there are others like the variation of water-level of Victoria Nyanza with the sunspot number, which can be discerned only when expounded by a knowing critic. The last chapter puts together what different watchers of the play see, each from his own corner. The development of the modern weather-map is described beginning with an investigatio by Le Verrier of the travel of a storm whic destroyed the British and French fleets a Sebastopol in 1854 to the latest Norwe gian mode in which the meteorologist trie to identify the different "air-masses" pre sent on the stage, and the places and time where they come into conflict and form an estimate of the relative strengths of th fighting forces, apparent and hidden, so a to give his verdict as to what the result o the fight will be. In an epilogue, Sir Napie gives us his idea of what the weather-map of the future will be—a map in which many vertical cross-sections of the atmosphere with actual temperatures (and moisture contents) and actual winds will be available to supplement the information given by the ground-map. In a very partial way, the wish is gradually becoming realised in different parts of the world.

Finely got up and enriched with beautiful pictures the book forms a most attractive introduction to Modern Meteorology.

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EXPERIMENTAL PHYSICS—A SELECTION OF EXPERIMENTS. By G. F. C. Searle, F.R.S. (The Cambridge University Press, 1934.) Price 16*s*. net.

The name of G. F. C. Searle is a household word among University students of Physics on account of the numerous pieces of apparatus of his designing which they meet with in their Practical Work. All these instruments display great ingenuity on the part of the designer and combine simplicity with precision to a high degree. We have already a number of books by the author in which experiments of an ordinary kind are shown to be capable of great variety. In the book before us a few experiments of an advanced character are selected from each of the following subjects, viz.,

Dynamics, Elasticity, Surface Tension, Viscosity, Heat and Sound, and described in detail with full discussions of the theory, the details of the design and the method of procedure. A very valuable part of each description is the numerical record of a specimen experiment with individual readings and calculation of results and errors set out so as to serve as a model to the student. Although the experiments described are not of a routine character, Honours students may profitably replace some of the stereotyped ones by those given in this book. The theoretical discussions are also original and a perusal of the book will give the student a good insight into the correct method of going about his practical work. Apart from the detailed descriptions of some ingenious experiments, the teacher will find that the book sharpens his own ingenuity towards designing new experiments to suit the conditions of his class: the author of the book is an admirable model to follow in this respect. We heartily recommend the book to the serious attention of all Honours students and teachers of experimental Physics.

T. S. S.

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CRYSTALS AND THE POLARISING MICROSCOPE. By N. H. Hartshorne and A. Stuart. (Edward Arnold & Co.) Price 16*s*. net.

The Polarising Microscope is of general aid in the examination of all kinds of solid material preparatory to its analysis, since examination with it may often indicate whether the material is homogeneous or heterogeneous, and may even suggest the best lines of carrying out the analysis. It has long been of use to the petrologist and the crystallographer and in recent years organic and inorganic chemists are also beginning to realise the value of the polarising microscope. This concisely written treatise would be of great help primarily to chemists and to other users of the polarising microscope who have at present little choice between elementary books intended for the junior student of geology and advanced treatises. The morphology and the optical properties of crystals are treated in a concise manner in the earlier chapters, and the method of using the polarising microscope both with parallel and with convergent light is treated in detail in the later chapters. A full chapter is devoted to the description and construction of the polarising microscope. Full details of the methods of examination of crystals for the determination of their size, thickness, refractive index, isotropism or anisotropism, pleochroism, etc., are given, and it is hoped that these chapters will be of use to students of physics as well. Examples are given of the uses of the polarising microscope in chemical practice. The get-up of the book is very nice and the language and presentation are agreeable. The fact that the price of the book is somewhat high at sixteen shillings is compensated by its value to all users of the Polarising Microscope whether they are physicists, chemists or geologists.

S. R.

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LABORATORY MANUAL OF COLLOID CHEMISTRY. By Harry N. Holmes. Third Edition, Rewritten and reset. Pp. xvii+229, 1934. Price 20*s*. (John Wiley & Sons, Inc., New York.)

Since its first appearance in 1922 the *Laboratory Manual* has held an esteemed place in the library of all colloid chemists, and the present edition which has been considerably improved and enlarged to include recent developments will be welcomed by all. Chapters on "catalysis and colloid chemistry" and "non-aqueous colloidal systems" have been added and many of the chapters particularly those on "adsorption," "surface and interfacial tension" have been enlarged and much useful matter added, the format of the volume remaining more or less the same.

We have gone through the volume with much profit and can offer nothing but praise for a volume containing such wealth of material so systematically arranged and so clearly presented. The author rightly points out in the preface that "when an unusual technic in the colloid realm is needed, it is believed that this manual will serve well as a reference guide." The get-up of the volume is excellent, and the binding is of the "vermin proof" type. The price of the book embodying so many useful features, appears to be quite reasonable, and we have no doubt that this book will find a place as a laboratory companion to all colloid chemists.

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INTRODUCTORY COLLOID CHEMISTRY. By Harry N. Holmes. xiv+198 pp. (John Wiley & Sons, Inc. New York.) Price 15*s*. 6*d*. net.

The book serves as a useful introductory text to the author's *Laboratory Manual of Colloid Chemistry* the third edition of

which has appeared along with this volume. The arrangement of the chapters follows closely that in the author's *Manual* and in several places even the wordings in the two volumes are similar. References to original literature are given for the benefit of the student. The author's intention to provide for the use of chemists, a "handy volume" on their desks, "to which they can turn for quick reference" has resulted in the publication of a useful introductory volume, which satisfies the demand for a brief general survey of the fundamentals of Colloid Chemistry.

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CONDUCTOMETRIC ANALYSIS, Principles, Technique and Applications. By Hubert T. S. Britton. Pp. xi+178, 1934. Price 12/6. (Chapman and Hall, Ltd., London.)

The last few years have witnessed a growing interest in the application of conductometric principles to chemical analyses, and the large amount of literature that has accumulated, has necessitated the writing of a monograph on conductometric analysis. We have had occasion to review a few of the monographs published by Messrs. Chapman and Hall under the Editorship of Dr. Howard Tripp, and the present volume which is the eighth in the series is admirably got up, and comes up to the ideals which the Editor has set himself in designing these publications.

Electrometric methods particularly those concerning the measurement of pH have been extensively employed in chemical analyses essential to the control of industrial processes, and in research. The aid of conductometric methods, which admit, perhaps, of a more extensive application, have been invoked by the physical chemists, only during the past few years, and these have already yielded very valuable data, and in a few instances, such as in the accurate estimations of very weak acids and bases, and the determination of the components of mixed acids, have proved invaluable. A large field concerning their application to industrial processes awaits investigation and as they can be applied to different types of solutions—coloured, opaque, colloidal, etc. and can be employed for the estimation of neutral salts in solutions, they possess advantages not obtained in potentiometric methods.

The book is a very handy volume comprising much useful information. The author has stressed the importance of the principle underlying conductometric analyses, a thorough grasp of which will be found of great utility in developing and extending this branch of analytical chemistry. Copious references are cited to original literature which will be found invaluable to the research student. One would have wished that all the citations were given at the foot of the page as this would facilitate collateral reading. There are one or two minor misprints such as 2·33 for 2·23 on page 32, last line in the table of values of $\frac{100-x}{x}$, column 4, and O.2N NaOH for O.2N HCl in line 3, page 140. A more comprehensive subject index too would have proved useful. The book fulfils a real need for a comprehensive account of the recent advances in conductometric analysis, and we have no doubt that it will be welcomed by all chemists.

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INTRODUCTION TO PHYSIOLOGICAL CHEMISTRY. Third Edition. Re-written and re-set. By Meyer Bodansky, pp. xi+661. (Messrs. John Wiley & Sons, 1934.) Price 25*s*.

The fact that the book has run through the third edition and is the tenth impression since 1927 stands out as a testimony to its great popularity. It is a well-known fact that the large output of research work in all branches of Biochemistry, renders text-books rapidly out-of-date and calls for revised and enlarged editions. While several monographs are appearing in various aspects of the subject, a text-book incorporating, in an eminently readable manner, the latest advances without losing the historical perspective, and yet condensed into a reasonable handy volume, fulfils a real want. Prof. Bodansky has set himself a greater task—that of providing to the student who needs more detailed information on specific subjects, references to literature,—journals, monographs, reviews, etc.,—and has brought out a work whose scope is more than that of a mere text-book. All these features contribute to the extreme popularity of this text-book.

The present edition incorporates several improvements. The references which have been brought up-to-date are cited as foot-notes and this will be welcomed by those who frequently resort to collateral reading. Several chapters have been re-written and those on enzymes, harmones, vitamins, etc., have been enlarged and made more

exhaustive, so as to incorporate the more recent advances.

The book is singularly free from printers' errors and should find a top place in the library of all physiological chemists.

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IRWIN CANAL SOIL SURVEY REPORT, SERIES I.—Introductory and General Part. By B. Narasimha Iyengar, B.A., Ph.D. Pp. 18+4 maps. (Printed at the Government Press, Bangalore, 1934.)

The above publication refers to the survey of a large area of land which will soon be brought under irrigation by the Irwin Canal in Mysore State. A third of the area may come under a monsoon crop like paddy requiring continuous supply of water, another third under dry crops requiring occasional supply of water and a further third under others requiring intermittent irrigation throughout the year.

The soil types are similar to those encountered in many parts of the Deccan plateau. The texture of surface soils (the first six inches) varies from stony to sandy and loamy in the pale yellow to light red groups, from loamy to sticky in the light red to deep red groups and from loamy to clayey in the grey soil group. The stickiness in red soil does not seem to be due to clay but to a large amount of colloidal iron oxide. Chemical analyses show that the soils are generally poor in regard to the essential mineral nutrients. Nitrogen content varies from 0·0062 to 0·099 per cent., but most soils contain only between 0·02 and 0·04 per cent. Total phosphoric acid is generally low and the availability, as determined by citric solubility, still less, ranging between 0·0002 and 0·021 per cent. All the soils would thus appear to be deficient in regard to available phosphorus. Potash content varies from 0·0085 to 0·077 per cent. and lime between 0·02 to 1·1 per cent. The reaction is mostly about neutral, the pH ranging from 6·5 to 7·5. Although the alkali content of the surface is generally less than 0·2 per cent., it is yet probable that with the altered conditions introduced by irrigation, the concentration may increase in some of the localities. Further research on this aspect is needed.

The latter part of the survey relates to a discussion of the lines along which the area should be developed in the future. Among the suggestions made by the author may be mentioned: (1) rapid extension of cane cultivation; (2) introduction of short season money crops; (3) creation of facilities for the cultivation of cocoanut, plantains and mulberry; (4) formulation of a drainage scheme in areas where alkali may tend to accumulate; (5) measures to preserve the cattle and sheep rearing industry of the tract; and (6) creating facilities for co-operative marketing of crops.

The author deserves much credit for the immense amount of work that had to be organised both in the laboratory and on the field. It may, nevertheless, be pointed out that some of the analytical data that would have thrown much valuable light on the nature and general fertility of the soils concerned are still wanting. There is no mention of any determination of the mechanical composition of the soils or their organic matter contents. Attention may also be drawn to the inadequacy of the citric solubility method when determining the availability of phosphorus in soils which are naturally rich in iron.

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BREEDING AND IMPROVEMENT OF FARM ANIMALS. By Rice.

Professor Rice has to be congratulated for getting up such a well-planned book on Animal Husbandry. It is lucidly written, well illustrated and the book itself is attractive.

The two chapters on the reproductive organs are a valuable addition to a book like this on Animal Husbandry. The author not only deals with all the aspects of the science of inheritance but explains the methods of breeding adopted in the breeding of animals. The chapters on fertility and sterility are interesting, but the Indian student should bear in mind that some of the facts such as age at first breeding and season for breeding are not wholly applicable to Indian conditions. From the scientific side of inheritance the Johnson theory of pure line has not been elaborated probably because it can be got from books like *Genetics in relation to Agriculture* by Balcock and Clausen and others. While he has brought up to date most of the work on sex determination, due weight has not been given to authentic cases of sex reversal in poultry.

The chapters describing the methods of breeding and grading, cross-breeding, in-breeding and selection will be very useful to both the teacher and the student of Animal Husbandry. The chapters on development and

fitting for sale and selling are useful to the student. It is surprising that more detailed information is not given with regard to artificial insemination on which a great deal of work is being done in Russia and some useful work is being done both at Edinburgh and Cambridge. The chapter on breed analysis and the four appendices, (*a*) Biometry, (*b*) Inheritance of Farm Animals, (*c*) Livestock Rural Association, and (*d*) Supplementary references will be useful to the research worker. Inheritance in farm animals is by no means complete nor do they all apply to Indian stock. The remarkable omission is the work by Buchanan Smith and his co-worker on the inheritance of milk in cattle. In the Jersey they have noticed indication of sex linkage for milk production—a very useful finding for the dairy cattle breeder.

This book will be found very useful to the teacher and student of Animal Husbandry and it should find a place in every Agricultural College Library.

Acknowledgment.

WE have pleasure in tendering our warmest thanks to the authorities of the Andhra University for their generous grant of Rupees *One Hundred* for the year 1934–35. It is gratifying to note that the Universities which foster and promote learning are appreciating the services of *Current Science*, thereby encouraging us to proceed forward in a spirit of progress and service.

We also take this opportunity to record our deep sense of gratitude to the Executive Council of the Nagpur University for renewing the annual grant of Rupees One Hundred for the year 1934–35.

Forthcoming Events.

LUCKNOW UNIVERSITY, FACULTY OF SCIENCE.

Special Lectures, Session 1934-35.

Feb. 5, 6, 7, at 6-30 p.m. Biology Theatre.
"The Distribution of a Simple Epidemic Disease." By Mr. J. A. Strang, Professor of Mathematics.

Feb. 9, 10, 11, 12, at 6-30 p.m. Biology Theatre.
"The Theory and Construction of Non-differentiable Functions." By Dr. A. N. Singh, Lecturer in Mathematics.

Feb. 13, 14, 15, at 6 p.m. Chemistry Theatre.
"Internal Secretions." By Dr. S. H. Zaheer, Reader in Chemistry.

Feb. 16, 18, 19, at 6 p.m. Chemistry Theatre.
"Artificial Colouring Matters." By Dr. S. M. Sane, Reader in Organic Chemistry.

Feb. 23, 24, 25, at 6-30 p.m. Chemistry Theatre.
"The Orientation of Molecules and Surface Reactivity" (Illustrated). By Dr. A. C. Chatterji, Lecturer in Chemistry.

Feb. 26, 27, 28, at 6-30 p.m. Biology Theatre.
"Parasitic Worms and Disease" (Illustrated). By Dr. G. S. Thapar, Reader in Zoology.

ELECTRICAL ENGINEERING SOCIETY, BANGALORE.

(The lectures will be delivered at the Indian Institute of Science at 3-0 p.m.)

Jan. 30th. "Frequency Multipliers." By Mr. N. R. Junnarkar, B.E.

Feb. 6th. "New Statistics." By Mr. M. K. Gopaliengar, B.Sc.

Feb. 13th. "An Automatic Rotary Sub-Station." By Mr. S. P. Divgi, B.Sc.

Feb. 20th. "Evolution of Electric Lamps and Illumination." By Mr. G. C. Kanitkar, B.E.

Feb. 27th. "Recent Advances in Carrier Current Art." By Mr. S. P. Chakravarti, M.Sc., D.I.C.

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